Design Engineering

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APRIL 1960

APR 7 1960

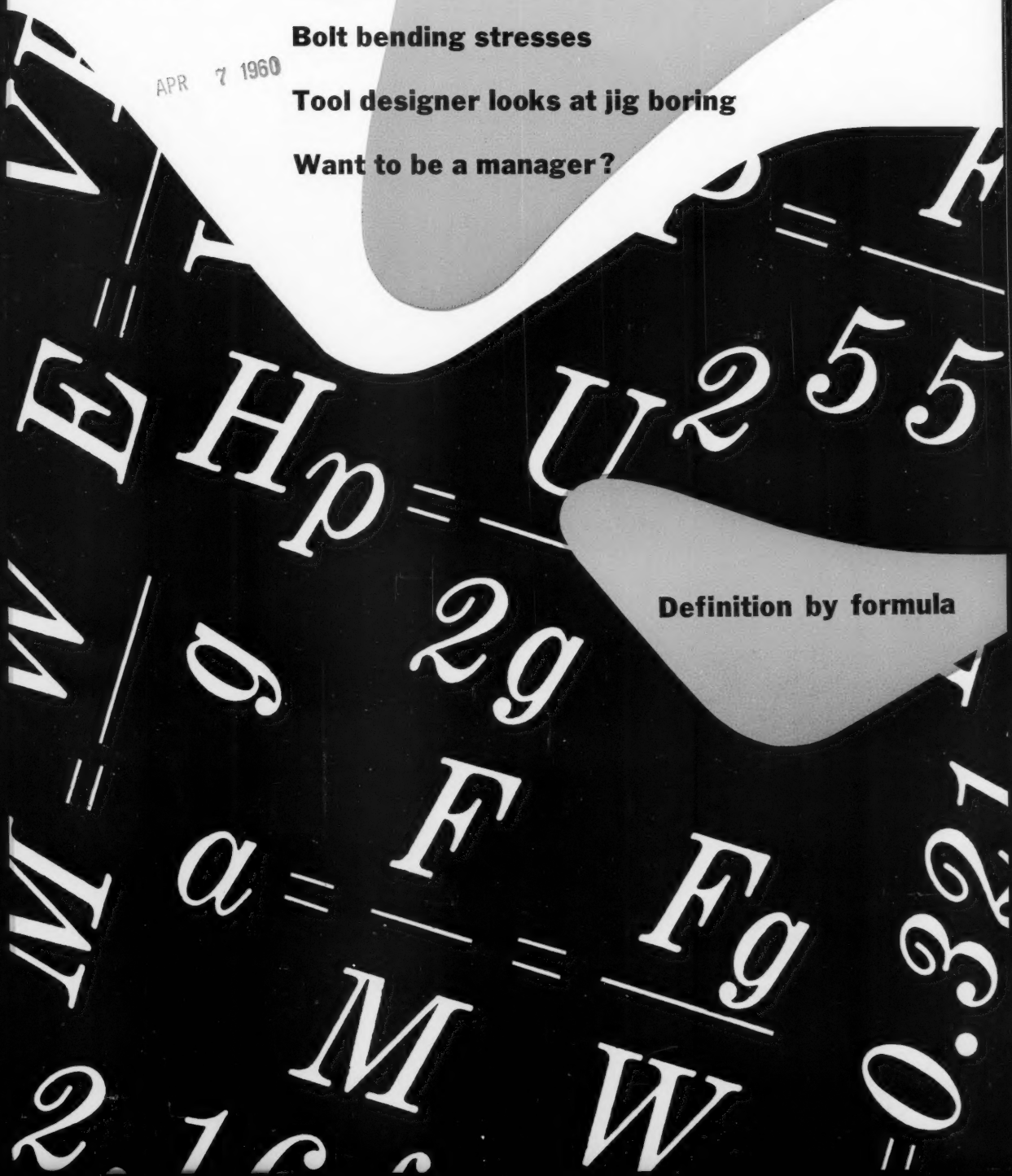
Bourdon tubes as curved beams

Bolt bending stresses

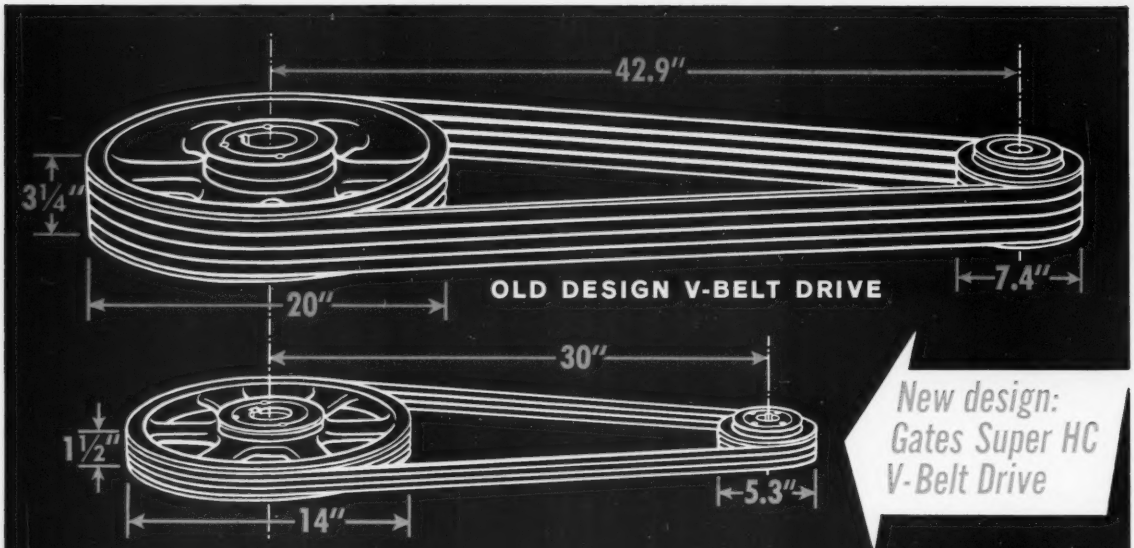
Tool designer looks at jig boring

Want to be a manager?

Definition by formula



Same horsepower... for same machine... ***new compact drive***



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Space savings provided by a typical installation:

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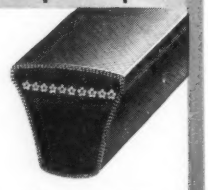
Super HC Drive	**5.3"**	**14.0"**	**30.0"**	**3**



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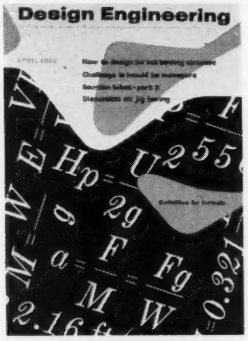

This month's cover

DE's art director Frank Davies really had himself a picnic with this one. Subject of his work is this month's two-page data sheet listing formulas which double as engineering definitions. If you can't decipher them on the cover, try the inside edition. You'll be glad you did.

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Treating Bourdon tubes as beams with external loading simplifies preliminary calculations—final design is obtained only by experiment.

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Bolt bending stresses 48

Screws and bolts are often subjected to bending or shearing stresses—this article features four ingenious methods of overcoming these stresses.

The railways — Canada's international design contributions 50

Conversion of the railroads from steam to diesel power is almost completed. The interesting story of No. 9000, the world's first successful diesel engine.

Design philosophy of new Austin 850 53

Introduced this month to the Canadian market, the Austin 850 boasts many interesting design elements: suspension, motor, size, braking.

Air curtain safely seals open door 58

Air curtain entrances are at full advantage whenever heavy traffic is encountered. Ideal for industrial applications with truck problems.

Design Engineering's $200 cash contest 60

An opportunity for every reader to enter contest—turn over the page right now to this important announcement.

Cost reduction is easy if you use shell molding 64

Introduction of this technique at a leading Toronto foundry has eliminated or reduced machining and other finishing costs.

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Rising to the top as manager is the aim of most conscientious workers—including engineers. Rate your potential with the ten tests outlined.

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Pass your copy along so that others may enjoy this service—there are three cards.

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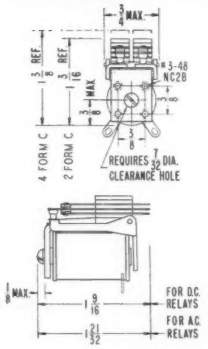
this is P&B's miniature MH relay

The MH is not a new relay.

As a matter of fact, we've been building and selling this series for seven or eight years. Its reliability and exceptional longevity have been proved in business machines, airborne computers and a host of other products.

Engineers like its fast action, its small size, its light weight. They like the wide selection of contact forms . . . up to 18 springs (9 per stack, DC) as well as the fact MH relays can be furnished to switch loads ranging from dry circuit to over 5 amps at 115 volts, 60 cycle resistive.

A multiple choice of terminations add to the MH's versatility. This relay, for example, can be adapted for printed circuits, furnished with taper tabs or a long list of other terminals. Get all the facts by calling your nearest P&B sales engineer today.



MH ENGINEERING DATA

GENERAL:

Breakdown Voltage: 500 volts RMS between all elements.

Ambient Temperatures: −45° C to +85° C. (−65° C to +125° C on special order.)

Shock: 30g on special order.

Vibration: 10g from 55 to 500 cps.; .065" max. excursions from 10 to 55 cps. on special order.

Weight: 2½ ozs. max. (open relay)

Terminals: Pierced solder lugs; special lugs for printed circuits, taper tab (AMP #78).

CONTACTS:

Arrangements: Up to 9 springs per stack.

Material: ⅛" silver standard: Palladium or gold alloy also available.

Load: Dry circuits to 5 amps @ 115V AC res.

COILS:

Resistance: 22,000 ohms max.

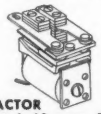
Power: 100 mw per movable min. to 4 watts at 25° C max. (200 mw min. to meet max. shock/vibration spec.)

Duty: DC: Continuous. AC: Intermittent (Two pole relay max.) open. Sealed units supplied with full wave rectifier inside can.

Voltages: DC: Up to 110 volts. AC: Up to 230 volts 60 cycles.

The relays below are variations of the MH relay structure.

MA LATCHING
Electrical latch, mechanical reset. Small, versatile and offered with selection of contact arrangements.



MB CONTACTOR
Contacts rated 60 amp. 28 volts DC non-inductive. Will carry 150 amp. surge for a duration of 0.3 seconds.

MH SEAL-TEMP
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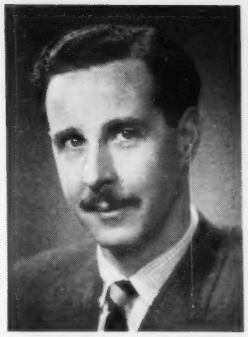
The contributors

Gone—but not forgotten

You've probably noticed that Eric Haworth's name has been missing from the masthead for the last couple months. No, he has not been fired—Eric has moved over and up as associate editor of Canadian Packaging, another Maclean-Hunter publication. The staff of DE wish him every success in his new appointment. Although he may have left the regular payroll, Eric has not forgotten entirely his old readers, and this month has authored the piece on the Austin 850.

Eric has had a very diversified and exciting career. He got his first newspaper experience as a cub reporter on his hometown paper in England. This was followed by four years in the British Army and two years at London University. He arrived in Canada in 1951, and has worked in advertising agencies, public relations, and as a special assignment writer for Eaton's. The past year has been spent as assistant editor of DE, where he will always be associated with the particular brand of humor which he introduced to the "Briefs."



Haworth

Kardos

Long, thin country on the Pacific

The author of "Bolt bending stresses" lives in the land of imaginative desserts (does pineapple and champagne sound imaginative enough?). Federico Strasser's the name—and Santiago de Chile the habitat. We must confess some envy. Way below the Tropic of Capricorn sounds a good place to be partner in a leading firm of electrical manufacturers. Strasser has contributed to DE regularly; his last bit was in the September, 1959 issue.

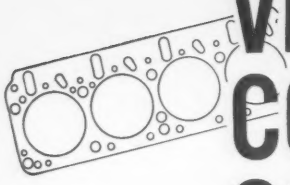
From Montreal way

Or should we have said "From out of the west"? In any case, G. Kardos, B.Sc., M.E., P.Eng., is now living in Montreal, and that's where we first heard of him. His early schooling was garnered in Saskatoon and he graduated from the University of Saskatchewan in 1948 with a degree in Mechanical Engineering. He returned to his studies later, and in 1958 received his Master's degree from McGill. Kardos has been employed with the National Research Council in Ottawa, as a project engineer with a leading motor manufacturer, and in 1954 joined Aviation Electric, where he is presently an engineering supervisor.

When Aviation Electric commenced manufacturing aircraft instruments, Mr. Kardos became interested in Bourdon tubes and today is a recognized authority on the subject. His article, quite naturally is entitled "Bourdon tubes designed as curved beams" and is the second of a three-part series. Our author is an Associate of the A.S.M.E., and a member of the "Mechanical Pressure Elements" subcommittee.

Reprints available

Reprints of the Feature Report which appeared in the February Issue on "The design and drafting office" are available. Price 25c each. Send your orders to Design Engineering, Department K, 481 University Avenue, Toronto 2, Ontario. *Cash with order.*



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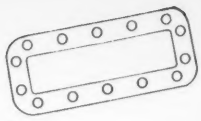
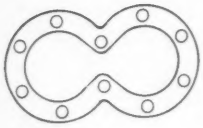


CORBESTOS® metal core asbestos

CORPAC® metal core rubber-asbestos



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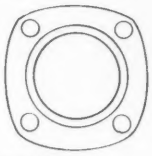

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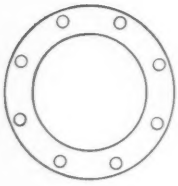

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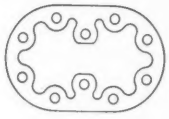

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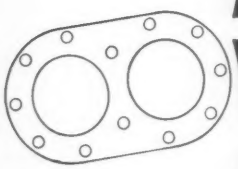

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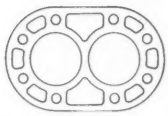

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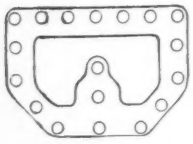

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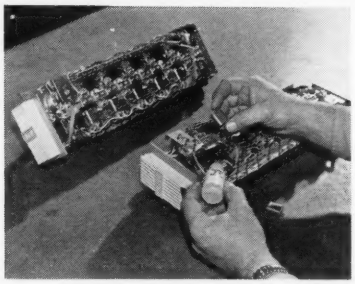
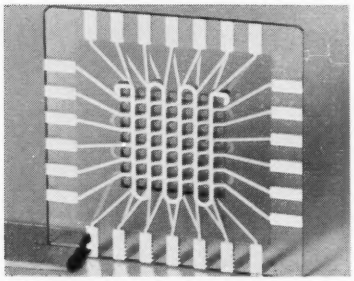
Reports — A world roundup of engineering and design interest

Imaginative dab of adhesive does the trick



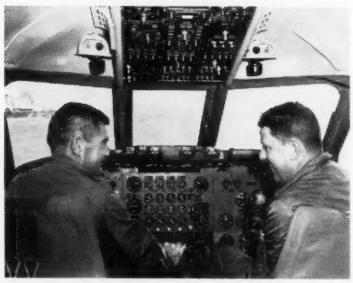
The old paste pot is gone but sticky stuff, in newer forms, is finding more uses in industry than ever before. Here is a case where electrical relays are being mounted on potentiometers. The relay cases are made of irodite-finished aluminum and the potentiometer covers of phenolic plastic. This particular team of components is placed in a digital attenuator system, DAS, that becomes part of an analog computer. Engineers at Electronic Associates Inc., where the unit is made, decided to attach each relay to its associated potentiometer and mount them as a single unit. This eliminated the need for relay mounting brackets and decreased the amount of wiring necessary. And all with a dab of adhesive — and imagination.

No jet nor prop but this plane will fly



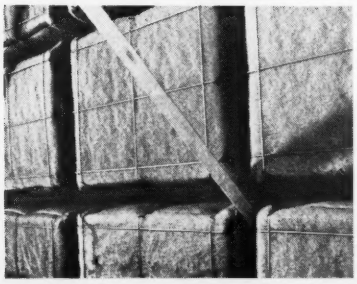
No elephant ever had a memory as good as this one. And it needs a good one just to remember its own name, which is: 84 Bit Coincidence Current Memory Plane. Memory devices such as this are the "honeycomb" of computer, brains. The function of storing electrical impulses is accomplished by the many little "bits" and their interlaced conductors. When the active part of a computer wants to make a mathematical comparison, or has a "need-to-know" directive, it may ask this memory for intelligence in the form of electrical pulses. This can be achieved by opening an electronic gate and allowing a voltage to trigger the final electrical or mechanical command. This particular thin-film memory plane is designed for airborne computers.

Icing and fogging go out the cockpit window



We won't ask you to spot the thermometer in this dazzling display of dials. Though in this story it's the significant instrument. The cockpit windows of this Convair jet are equipped with a temperature control system, said to be the most advanced yet devised, to prevent exterior icing and interior fogging. The control units are self-regulating and consist of high-gain magnetic amplifiers that are used for proportional and integral control of window panel heating power. Elements take the form of films. One set near the exterior surface of the window, another near the interior surface. Required temperature range of plus or minus 2F is maintained with special circuitry in the amplifiers. Temperature controls are designed to automatically compensate for resistance changes in the films due to aging.

No Eskimo architect ever built an igloo like this

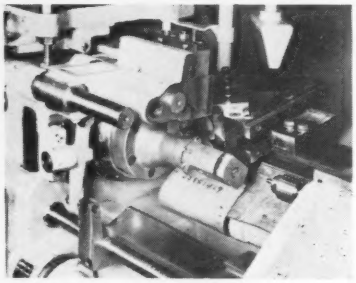


With a name like Ulok you might think that these cubes form the sides of an igloo. But you can put away your Eskimo dictionary, for these furry forms are air filters. Shaped like an open box the filter is made up of three components: a disposable filter medium, two inches thick, made of Dynel modacrylic; a wire basket into which the medium fits; and a rustproof retainer wire that fits inside the medium to hold it rigid. Theory is that the air stream carries the dirt into the cube and to the inside surface of the downstream face of the filter. As dirt builds up on the downstream face, air flow is shunted to the other four sides of the cube utilizing the medium there. Field tests carried out in New York City seem to indicate that the theory works in practice.

Engineers stem the blankety-blank of paper men

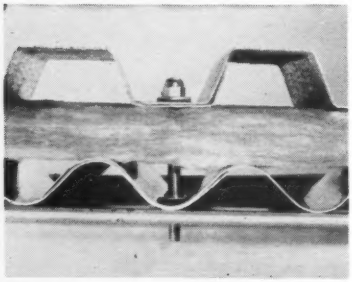
The mild manner of pulp and paper engineers usually explodes into a stream of white hot expletives when a chunk of tramp metal gets into their precious chipper blades. Appalled at such rich language a group of Canadian engineers at Measurement Engineering Ltd., got together and came up with the metal detector you see here. Since installation at a Quebec mill it has not only soothed tempers but has also saved thousands of dollars. The equipment consists of a search head that finds the metal and a control unit that automatically stops the conveyor so that the offending log can be removed. The detector is sensitive to all metals, in varying degrees, even when buried in the wood. Incidentally this is the largest detector ever built but even larger ones are quite practical.

Five jobs and savings turned on retooled lathe



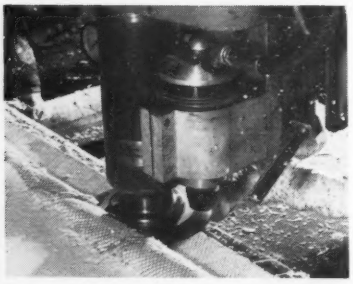
Five simultaneous operations per cycle with a single spindle machine means money saved. Acting on this premise a prominent manufacturer in the automotive field equipped an automatic lathe with special tooling. Result is a single operation that bores, faces, chamfers and turns a piston skirt while centring the closed end. Because all tools operate simultaneously cycle time is minimized. The operator simply loads and unloads the machine. The piston is clamped into position with three air-operated jaws. Boring, turning and facing of the open end of the skirt is accomplished with tooling mounted on an overhead slide. At the same time a chamfer is made using a 45-degree squaring attachment mounted on the rear of the lathe.

Architects picnic? — stainless screw fastens sandwiches



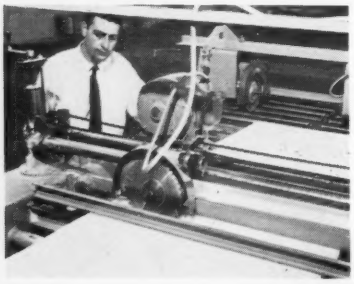
If you're a conundrum fan try your hand at this one: "A toothpick is to a sandwich what a stainless steel fastener is to a 'sandwich' wall." Not being partial to toothpick sandwiches, we found it a little difficult to puzzle out for ourselves. We went to Fabricated Products Co. for the answer. Seems they were talking about a new stainless steel fastener they are making for curtain walls. It's a self-tapping screw that replaces the three separate fastening steps used in the conventional methods. The fasteners work in combination with any of the materials currently being used in curtain wall construction. Final fancy touch: the washers and cap nuts of the bolt are supplied in colors to match building exteriors.

Forecast — snow and ice turning to savings



If you haven't already seen enough snow and ice this winter (and who has?) maybe you can bear to take a look at this. It's a novel form of chuck dreamed up by engineers at Rohr Aircraft Corp. Idea is to prevent deformation of the honeycomb during cutting. The honeycomb is filled with water or soap and frozen on the table of the milling machine. However, the Rohr people are even more excited about the cutter you can also see. They recently switched from steel to carbide cutters. The improvement was staggering. Cutting stainless steel honeycomb the old steel cutters were good for about 75 sq ft per grind. The carbide rings, clamped on a steel disc, will cut more than 10,000 sq ft per grind. Savings on grinding and honing costs: incredible 5,200%.

Polyethylene protection for atomic age sailors

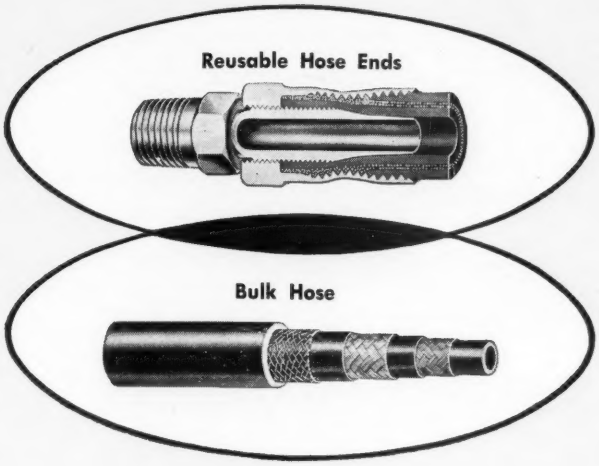


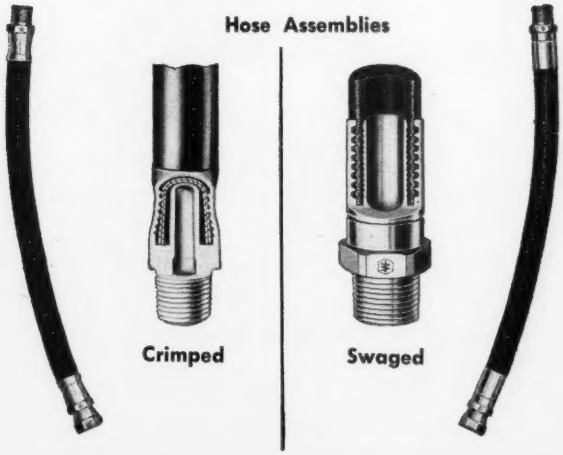
Atomic-powered ships need radiation shields. Trouble is that concrete and lead, the conventional materials, have notably poor flotation. Search for a lighter material has produced Petrothene 100. But, trouble again. The panels need to be so thick that special saws had to be designed to cut them. Engineers at St. Regis Paper Co., where the panels are made, overcame the problem. Here you see their new tool at work. Material is compounded of polyethylene resin with one or two percent boron. The hydrogen nuclei in the polyethylene successfully reduce the energy in the high energy neutrons created by atomic fission. The boron absorbs the remaining low energy neutrons. Panels are made by a specially adapted extrusion technique.

WEATHERHEAD

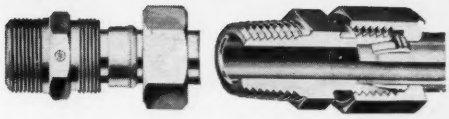
First in components for HYDRAULIC SYSTEMS

Look at anything . . . anywhere in the world . . . in hydraulics, diesel power or machine tool applications . . . equipment for instrumentation, oil drilling, mining, road building, petro-chemicals or even atomic power . . . chances are the vital air and fluid lifelines are secured with WEATHERHEAD.

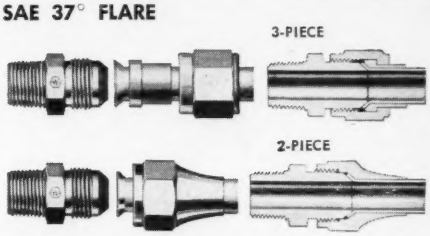




ERMETO®



SAE 37° FLARE



SAE 45° FLARE

INVERTED FLARE

COMPRESSION

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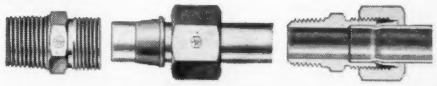
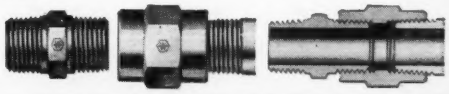
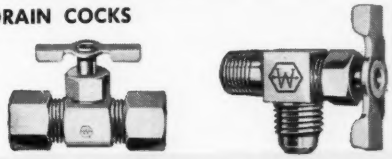


PIPE



DRAIN COCKS



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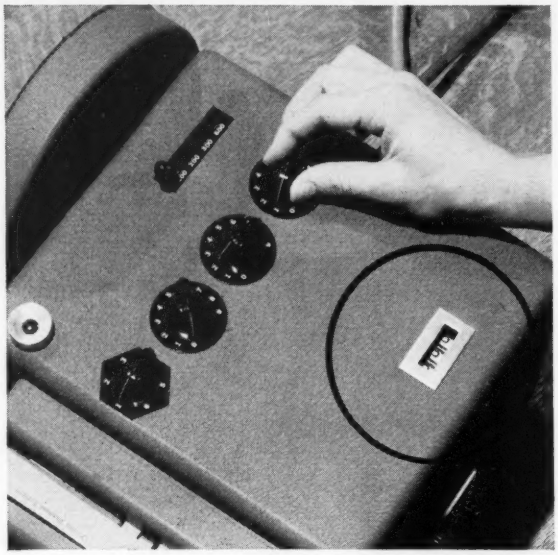
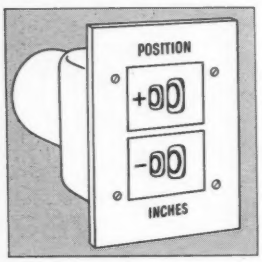
Veeder-Root READOUT Bulletin

Readout Counter used in Tape Preparation for Machine Tool Control

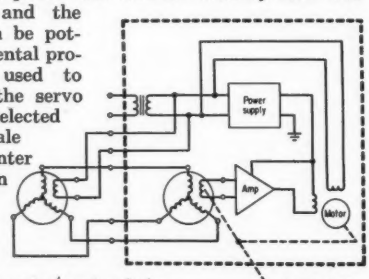
A Veeder-Root Series 1538 Remote Data Readout Counter provides tape feed control for the motorized tape punching unit of the new Potter & Johnston Tape Control System. The tape punch is used to program machine functions on P & J Automatic Turret Lathes. The counter automatically controls the amount of tape feed required for each turret face involved, and stops the tape at preselected address points. When the correct address point is reached, a combination of holes representing the machine command is punched into the tape. Counter is automatically reset for each turret face.





Servo Repeaters Drive Counters to Indicate Lineal Motion*

One of the ways to take advantage of digital readout for indicating and recording information at remote points is through servo repeaters. Applications in aircraft, for altimeters, navigational displays and similar instrumentation, suggest many other opportunities to use counters for more positive indication and control. A typical "system" is shown here where a counter is used for indicating nuclear reactor rod position. The servo repeater and counter actually form one packaged unit, and the whole device can be potted for environmental protection. When used to drive counters, the servo gear ratio is best selected to provide full scale travel of the counter for one revolution of the control transformer shaft.



Typical servo repeater/counter device that converts synchro data to digital readout.

Let Veeder-Root help you make Counters do more! Extensive design experience and precision production techniques make it possible for Veeder-Root to help you solve a wide variety of digital, readout, control and recording problems with counters — from the simplest ratchet to advanced readout and navigational devices. Send for information on specific applications or contact your local Veeder-Root Counting Engineer.

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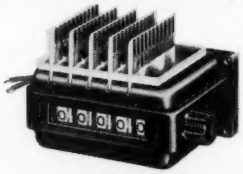
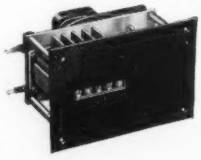
Veeder-Root Readout Device

This is the basic series of Remote Data Readout Counters. Some are available for standard applications, or design variations will be submitted based on requirements. They function basically as analog to digital converters.

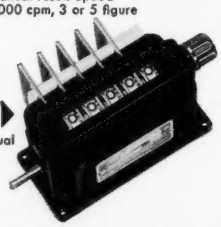
Series 1538/electrical reset/ electrically actuated. Speed 1000 cpm, 3 or 5 figure





Series 1538/electrically actuated/ manual reset. Speed 1000 cpm, 3 or 5 figure

Series 1606/mechanically actuated manual reset standard; bi-directional (non-reset) available. Speed 5000 cpm, up to 5 figures



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Railway design

After all the furore created when the CNR appointed a U. S. design consultant in 1959 (see DE, September p. 104) we are happy to report that the CNR has retained a Canadian design firm to assist in preparation of interior design, planning and decor for the railway's new head office in Montreal. The company is Designs For Business of Canada, Ltd., a Montreal firm headed by S. R. Shefler.

U. S. engineering manpower

Undergraduate engineering enrollment in the U. S. for the current term registered another decline, the second consecutive one. Because of the lower enrollment and higher failure rates, the graduating classes for the next five years will average 37,500 compared with the pre-1958 prediction of 43,000.

Nuclear symposium

AECL will play host at a symposium to be held Sept. 6-8 at the Chalk River laboratories. Topics to be discussed will include the chemical and nuclear interactions of excited atoms, experimental studies of the fission process, properties of nuclei, and new techniques in nuclear chemistry. For further information write Dr. R. H. Betts, AECL, Chalk River, Ontario.

What was said

"If wages in Canada keep on rising at the rate they have been doing, then I have great fear for the future of Canadian industries." — T. R. McLagan, vice-president of Canadian Manufacturers' Association.

"When the DHO lets a contract, it is also buying the contractors' reputation . . . the DHO believes that a truly responsible contractor is not merely building a highway — he is also building his integrity, know-how and reputation into the work." — Honorable F. M. Cass, Ontario Minister of Highways.

"One of the basic needs is to find out what the customer really wants. To be successful, a design engineer must design a product which customers will buy at a profit to his company." — A. R. Rising, vice-president Borg-Warner Corporation.

"It is my belief that we Canadians and Americans are going to have to accept a decrease in our standard of living in the not too distant future if we hope to maintain our freedom." — C. A. Stollery, P.Eng., President, Association of Professional Engineers of Alberta.

Curtain wall contract

The largest contract ever let in the Commonwealth for a curtain-wall (a wall which garbs a structure without supporting it) has been awarded to Canadian Pittsburgh Industries Limited for the 42-story cruciform office building of Place-Ville-Marie in Montreal. The contract exceeds four million dollars.

Uranium lesson

Cancellation of its contracts for Canadian uranium by the United States is one more illustration of how capricious and uncertain are the foreign markets for the products of our extractive industries.

It also points up again that, important as these industries are to the national economy, their existence alone —unsupported by manufacturing industries—is far from being a guarantee of stable and continuing growth for the communities which are dependent upon them.

The truth is that some manufacturing industry — Canadians producing for Canadians — will always be an indispensable requirement for a safe economy.

CBEMA head

Robert R. McCreary, of Executone Communications Ltd. has been elected president of the Canadian Business Equipment Manufacturers' Association. W. R. Woodrow (Smith-Corona) is the new vice-president and A. O. Dawson (Underwood) secretary treasurer.

CBEMA is the sponsor of the Canadian Business Show which will be held June 6, 7 and 8 at the Exhibition Park, Toronto.

Gray iron casting clinic

How to cut costs in designing and purchasing gray iron castings will be the subject of a one-day clinic to be held in Toronto, April 14. Class limit will be 40 men. For further information write Gray Iron Founders' Society, National City, East Sixth Building, Cleveland 14, Ohio.

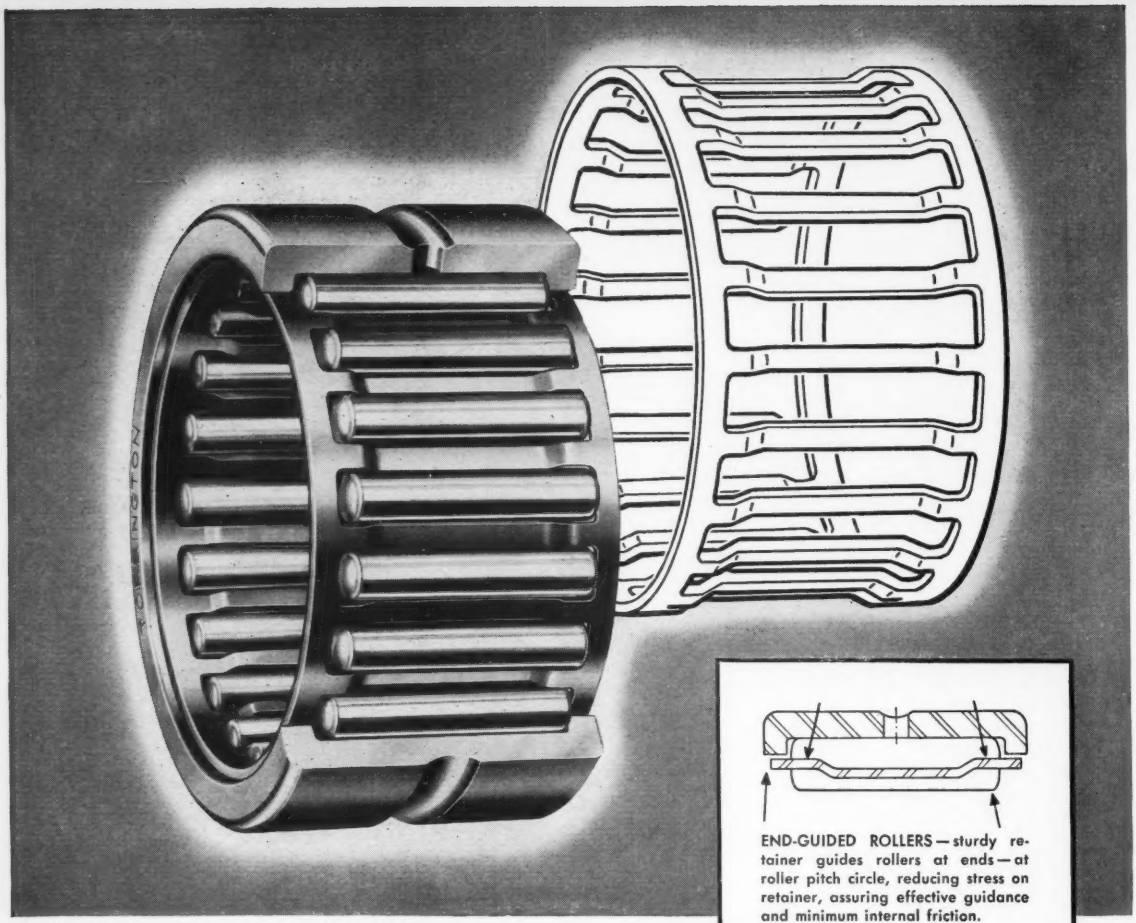
Ottawa report

Don Peacock, Ottawa editor

There are opportunities for Canadian exporters in Sweden, says Trade Minister Churchill . . . manufactured items such as office machinery, power saws, auto parts, and steel components are finding a market there.

President Claude Jodoin of the Canadian Labor Congress is quoted "We are not opposed to automation and other changes which will bring increased efficiency. We do think there is a very real need for advance warning of these changes . . . to avoid the human suffering and wastage which can easily result."

Figures tabled in the Commons by Defence Production Minister O'Hurley show that a record $96.3 million worth of United States prime defence contracts and subcontracts were placed in Canada during 1959. This compares with $37.9 million for 1958 and the previous high of $58.7 million in 1957.



The New *Torrington Heavy Duty Roller Bearing*

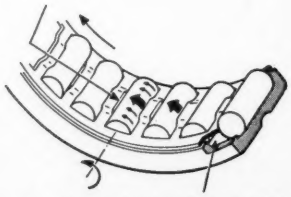
Key to Long Life... Roller Guidance Where It Counts!

This sturdy flange-riding retainer in Torrington Heavy Duty Roller Bearings insures the highest degree of roller guidance where it's most effective... at the roller ends along the pitch circle. You get outstanding service life through minimum internal friction, high roller stability and efficient lubrication.

Controlled contour rollers prevent high end-stress concentrations. Careful heat treatment of the channel-shaped outer race insures high shock resistance. The Heavy Duty Roller Bearing has proved successful under unusual conditions of deflection or misalignment. Torrington Heavy Duty Roller Bearings are giving longer life in such difficult applications as two-cycle engines, hydraulic pumps, oil-field equipment, sheaves and transmissions. For design and application assistance on the Heavy Duty Roller Bearing—and every basic type of anti-friction bearing—call your Torrington District Engineer.

END-GUIDED ROLLERS—sturdy retainer guides rollers at ends—at roller pitch circle, reducing stress on retainer, assuring effective guidance and minimum internal friction.

UNIFORM LOADING—Torrington controlled contour rollers eliminate stress concentration at roller ends. End-stress pattern of unrelieved cylindrical rollers is shown in black outline. Area in gray shows uniform loading over entire contact length of Torrington rollers.



AMPLE LUBRICANT STORAGE AREA is provided by the retainer design, which also allows unrestricted flow of lubricant within the bearing.

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THE TORRINGTON COMPANY, LTD. 925 Millwood Road, Toronto 2, Ontario

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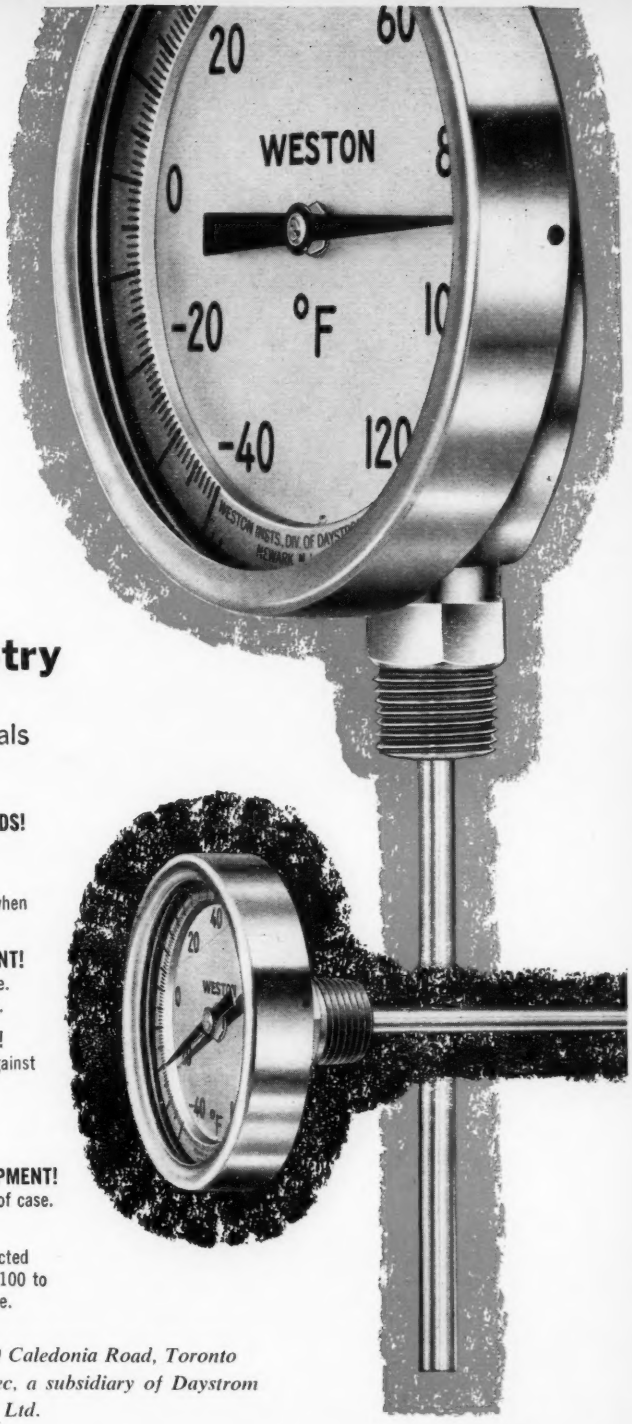
Weston Presents

a new departure in industrial thermometry



The new 4000 series of heavy-duty bimetals offers these 7 points of distinction:

- **ALL-STAINLESS-STEEL CONSTRUCTION, INCLUDING WELDS!**
  A new high in ruggedness and serviceability is achieved.
- **IN-LINE SCALES ELIMINATE PARALLAX ERROR!**
  New scales lie in the same plane as pointers—no misreading when mounted away from eye-level.
- **REMOVABLE BEZELS PERMIT EASY WINDOW REPLACEMENT!**
  Heavier scale glasses stand more punishment without breakage. In the event of a mishap, windows can be replaced in the field.
- **NEW COMPOSITION GASKETS PROVIDE OPTIMUM SEAL!**
  This newly-developed material assures maximum protection against "breathing" and leakage.
- **ACCURACIES OF ±1% ARE ASSURED!**
  Guaranteed accuracies of 1% of range.
- **EXTERNAL ADJUSTMENT FEATURE IS STANDARD EQUIPMENT!**
  A readily accessible Allen screw adjustment is located on side of case.
- **FULL LINE OF SIZES, STEM LENGTHS AND RANGES!**
  3-inch and 5-inch diameter heads . . . back and bottom connected models with rotatable scales . . . ranges cover an area from —100 to 1000F or —100 to 500C . . . standard stems up to 72" available.

For full information, write to Daystrom Limited, 840 Caledonia Road, Toronto 19, Ontario or 5430 Ferrier Street, Montreal, Quebec, a subsidiary of Daystrom Incorporated, or any office of Northern Electric Co. Ltd.

WESTON *Bi-metal Thermometers*

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These are just a few examples of the many thousands of different springs produced by Wallace Barnes in lots of a few . . . or thousands. The successful production of this large variety depends on the knowledge and experience of the Wallace Barnes team of engineering experts. These men, skilled in every phase of spring-making, guarantee the most efficient design, the most durable product, and the most economical production in any quantity.

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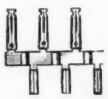

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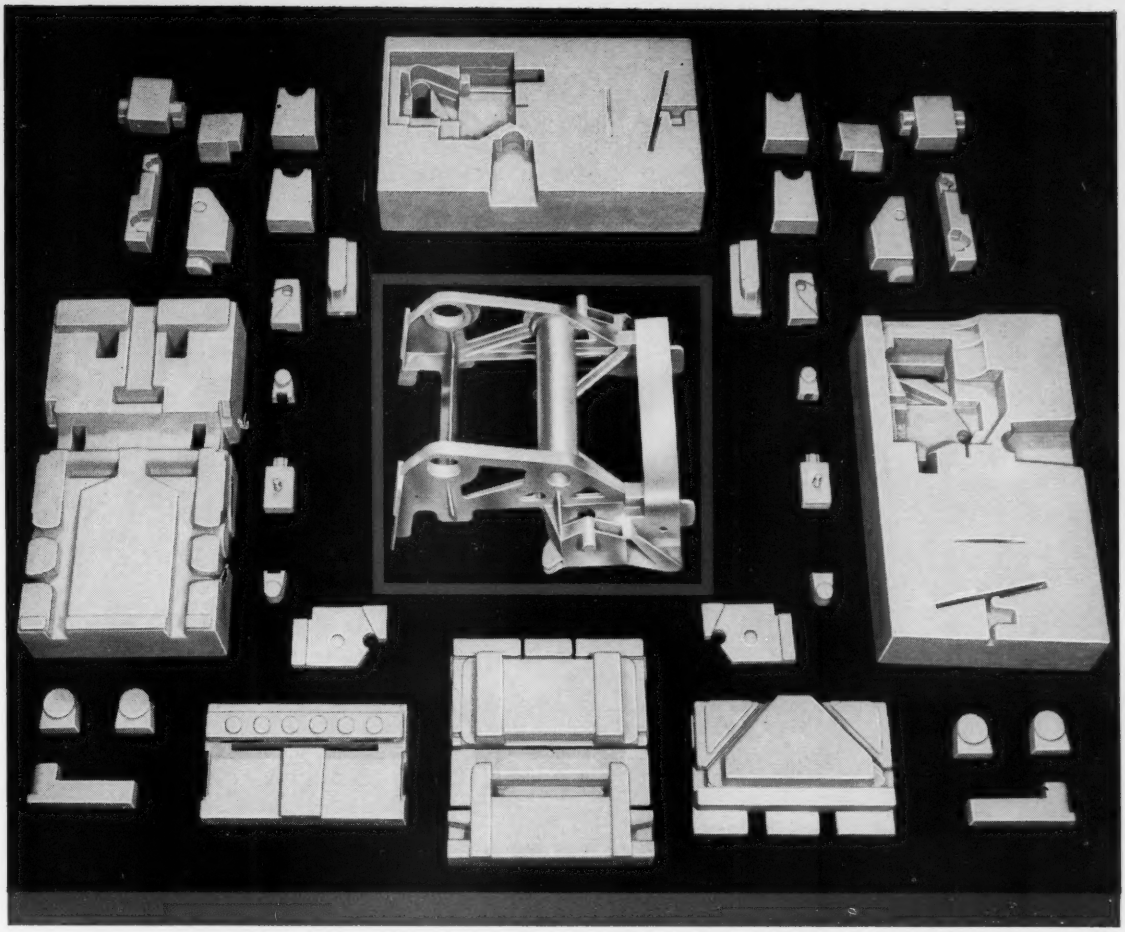

How RCI FOUNDREZ CORE BINDER Helped AMERICAN BRAKE SHOE Meet MIL-C-21180A

To produce the strong, dimensionally precise, lightweight casting shown above, the Light Metals Department of American Brake Shoe Company in Mahwah, New Jersey called upon two of the latest advances in metalworking technology . . . Ductaluminum, a relatively new and stronger aluminum alloy and RCI's FOUNDREZ liquid amino-aldehyde core binder. Used together, they now make it possible for foundries to meet military specifications in castings of this complex nature. ■ Thirty-six individual cores (see illustration) are required to produce this jet canopy casting. And why does American Brake Shoe choose RCI FOUNDREZ for this application? Four factors are involved: **1.** *RCI's liquid amino-aldehyde core binder provides better binder distribution in the core sand which contributes to exact casting dimensions and keeps surface defects at a minimum.* **2.** *The advantage of dielectric baking, and the high core strength obtained, increases core production and speeds core handling.* **3.** *Excellent core knockout and collapse qualities, at the lower pouring temperatures of aluminum, speed production and reduce the cost of finishing.* **4.** *RCI's reputation for on-time delivery and prompt technical service.* ■ If you are pouring metal castings at temperatures below 2700° F, we suggest you investigate the improved core properties offered by RCI's FOUNDREZ liquid amino-aldehyde binder. Reichhold will deliver this unique resin to you from seven convenient shipping points in tank cars, tank trucks or drums. Write today for Technical Bulletin F-2-R for full data on RCI's FOUNDREZ 7600 series.

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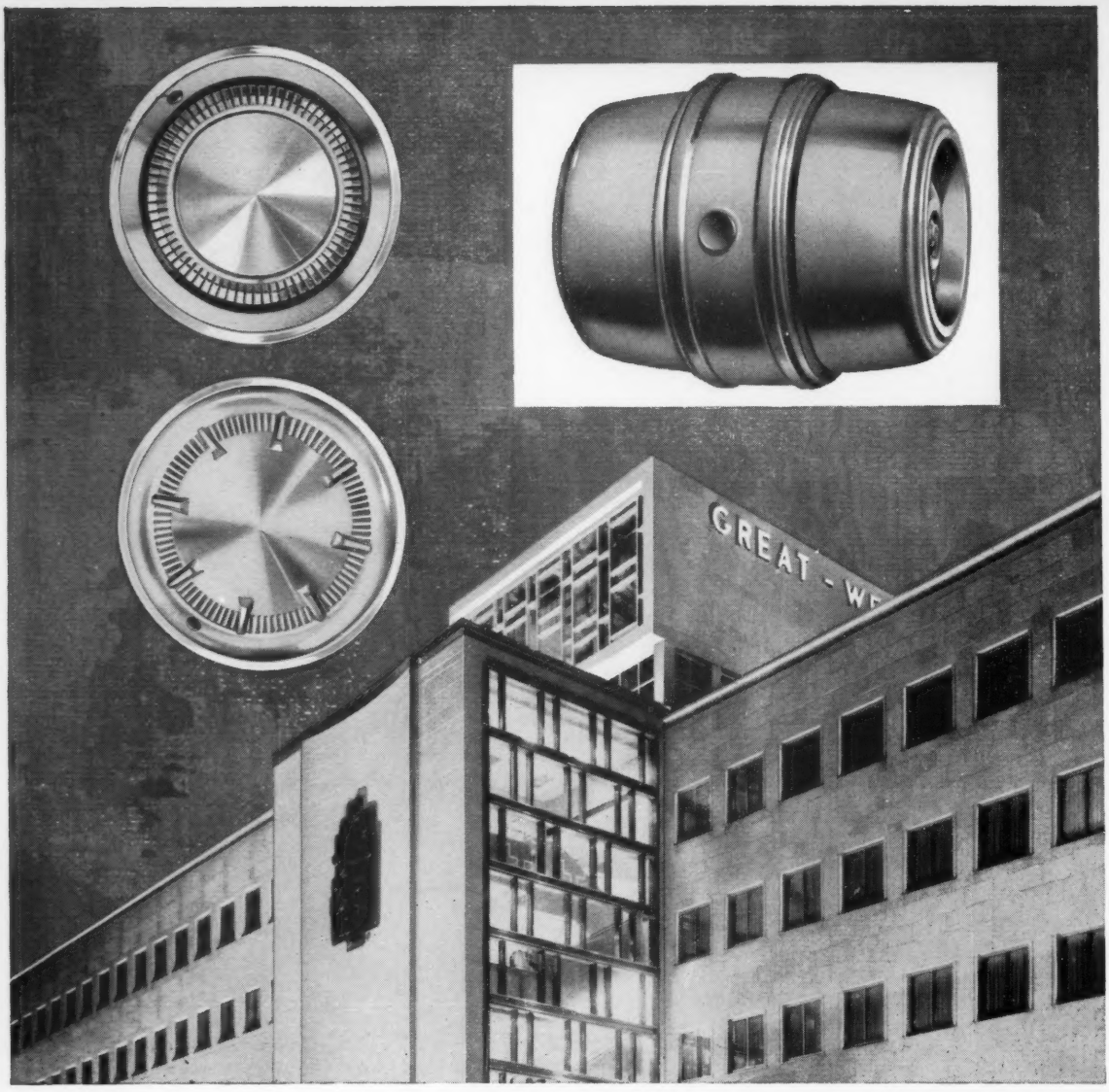

EVERY CANADIAN INDUSTRY HAS SOLVED TOUGH PROBLEMS WITH STAINLESS STEEL FROM ATLAS

A new product means new problems—and wherever possible design engineers solve these problems with proven materials. That's why stainless steel has been used by every manufacturing industry in Canada.

What do designers like about stainless steel? First of all stainless is easy to work with. No tolerance is needed for corrosion because there *is* no corrosion — and stainless needs no painting or plating. But probably the biggest asset is the acceptance both industry and the consumer have for stainless.

Investigate the possibilities of using stainless in *your* next project. You'll be pleasantly surprised at the number of expensive operations that can be eliminated.

In Canada the largest producer of Stainless Steels—and the company best equipped to assist you—is Atlas. For answers to your questions about steel, contact your nearest Atlas representative.

ATLAS STAINLESS STEELS

ATLAS STEELS LIMITED, WELLAND, ONT. Warehouses: MONTREAL, TORONTO, HAMILTON, WINDSOR, WINNIPEG, VANCOUVER. Representatives: LONDON, ST. CATHARINES, SUDBURY

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offer you economy... efficiency... and a wide range of opportunities

PLASTICS	PROPERTIES	TYPICAL USES
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* *New product made by Du Pont of Canada Ltd. ALATHON** Distributed in Canada by Du Pont of Canada Ltd. MARLEX† Distributed in Canada by Du Pont of Canada Ltd.	Densities from 0.914 to 0.960; in all melt indices; at least one formulation for every conceivable use. Outstanding processability over a wide range of properties. No other single supplier can offer so complete a variety of densities.	Film; moulding (housewares etc.); pipe; wire insulation; cable jacketing; extrusion coating of paper, cloth, etc.; blown and thermoformed containers; mechanical parts; sheet for thermoforming; monofilament for rope, industrial cloths, seat covers.
NYLON RESINS "ZYTEL" Made in Kingston, Ontario, by Du Pont of Canada Ltd.	High strength and fatigue resistance over wide temperature range; excellent abrasion resistance, low friction co-efficient. Easily moulded in properly adjusted equipment. Special extrusion grades available.	Wear parts for machines (bearings, gears, cams, bobbins, toggles, etc.); locks; hardware; plumbing fixtures; fasteners; wire and cable jackets and sheaths; switch parts; heat and impact resistant housings; oil resistant tubing.
"TEFLON"** FLUOROCARBON POLYMERS	High heat resistance, lowest friction co-efficient, chemically inert and insoluble. Outstanding as an electric insulant. Requires special equipment and processes for moulding and extrusion. Also available as dispersions.	Gaskets; packings; bearings; seals; insulators; anti-adhesive coatings and coverings; high temperature wire coatings.
"DELRIN"** ACETAL RESIN	Exceptionally high strength, stiffness and fatigue resistance; high heat resistance; low friction co-efficient; low water absorption. Easily moulded in properly adjusted equipment. Extrusion grade available.	Mechanical parts; hardware; pipe fittings; tool parts and housings; extruded tubing and trim.
"LUCITE"** ACRYLIC RESIN	Clarity; colourability; weather stability; wide moulding range; craze resistant; outstanding processability. Powdered resins also available.	Moulding of lenses, lighting fixtures, escutcheons, brush backs; extrusion of rod, tube, sheet for thermoforming of signs, letters, diffusers, etc.; lacquers, adhesives, etc.

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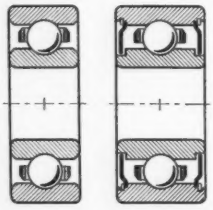
Address: _____

BARDEN "T" retainer combines aluminum and phenolic for greater strength, superior performance



"T" retainer bearings are available in chrome or stainless steel, open or shielded, from .5000" O.D. to 3.3465" O.D. in standard widths. Also available: extra-wide shielded sizes with increased lubricant space for still longer life. For complete technical information write for Engineering Data Sheet T-1.

Doubles bearing life in high speed applications

Power tools, gyro rotors, aircraft and missile accessories and other high speed applications require bearings that combine high load capacity and endurance at speed. To meet these exacting demands, Barden developed the "T" ball retainer which combines the advantages of phenolic with the strength of aluminum.

The two-piece "T" retainer has laminated phenolic center sections bonded to high-strength aluminum alloy side plates. It is securely joined by body-bound rivets tightly headed against metal at both ends. The retainer's thin cross section permits maximum exposure of balls and raceways to lubricant. Outer ring piloting provides optimum lubricant circulation.

These features, together with high load capacity, result in longer, trouble-free bearing life. For example, double shielded, grease lubricated "T" retainer bearings have operated continuously in textile spindles for more than 18,000 hours at 30,000 RPM.

Like other Barden advances in engineering and manufacturing, "T" retainer bearings solve a specific performance problem. Other Barden Precision ball bearings satisfy such extreme demands as:

- High temperatures (to above 400° F.)
- Low torque (to 10 dyne-cm. for 2 lb. load)
- High speeds (to over 300,000 RPM)
- Concentric rotation (to .00005" max. T.I.R.)

The complete Barden line includes sizes from .0469" bore to over 3" O.D., all manufactured to Barden Precision standards of dimensional accuracy, uniformity and reliability. Refer to Sweet's Product Design File (8h/Ba) for Barden catalog and bearing selection guide.

for reliability...specify **BARDEN PRECISION BALL BEARINGS**

PHILIP FRENCH SALES, LTD. — Exclusive Agent in Canada
8425 Mountain Sights Avenue, Montreal 16
57 Dromore Crescent, Willowdale, Ont.

For further information mark No. 107 on Readers' Service Card

TAKING THE TEMPERATURE OF QUALITY

The thermocouple shown here is as vital to the Noranda Metallurgist's job as a clinical thermometer is to a doctor of medicine. It is an essential link in the chain of quality control which, at Noranda, starts in the mine and continues through every stage in the production of Noranda copper and copper base alloys.

Noranda's complete range of rod, wire, strip and tube is quality-controlled to assure Canadian industry the ultimate in mill products for economical fabrication. Consistently high quality makes Noranda the prime source for copper, brass and bronze in Canada. We invite your inquiries for information and technical assistance.

THE KEY TO THE BEST IN METALS

Noranda Copper and Brass Limited

SALES OFFICES: Montreal • Toronto • London • Edmonton • Vancouver

ASSISTING YOU TO PUT THE RIGHT BEARING IN THE RIGHT PLACE

SKF OFFERS A COMPLETE BEARING SERVICE, INCLUDING

- experienced engineers to work on your problems
- vast research and laboratory facilities
- technical books of outstanding value
- data on bearing applications throughout the world
- and, of utmost importance, an engineering inspection service that follows through from specifications to completed job.

We invite engineers and designers to make use of these special services.

SKF

THE FINEST BEARINGS IN THE WORLD

CANADIAN SKF COMPANY LIMITED

Head Office and Manufacturing Division:
2201 Eglinton Ave. East, Scarborough, Ontario
District Offices and Authorized Distributors Coast to Coast

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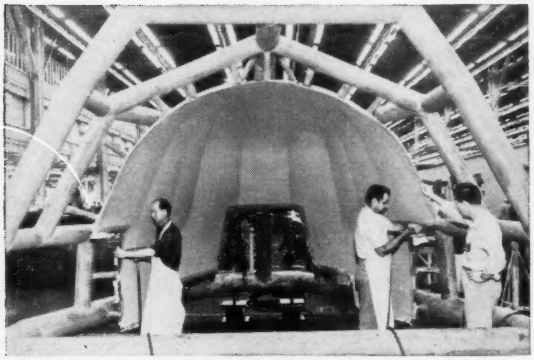
1 The tube is a reinforced epoxy housing that protects:
(a) a communications antenna (b) a radio transmitter
(c) miniature rockets

2 Its ignition coil, completely embedded in epoxy, is safe from:
(a) moisture (b) temperature extremes
(c) shock

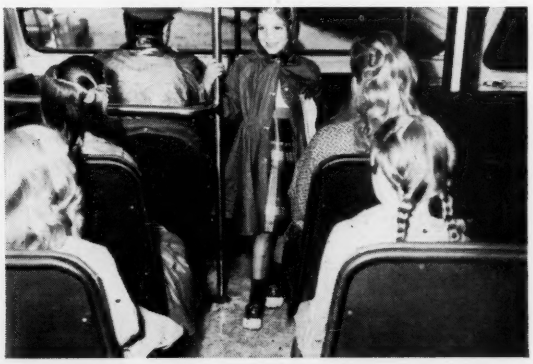
Can you pass this test on Epoxy Plastics?

(You'll profit by knowing them better)



3 This airplane construction tool of epoxy-glass cloth:
(a) checks dimensions of fuselage (b) supports the frame
(c) is part of the mock-up

4 This tough, strong, pleasure boat hull is made from:
(a) laminated epoxy and glass fiber (b) epoxy-coated wood
(c) epoxy-coated metal



5 Their trip to school is safer in a bus with:
(a) epoxy-glass fiber seat frames (b) an epoxy-sand coated floor
(c) epoxy-embedded electrical parts

ANSWERS... *to tomorrow's needs are coming from adaptable BAKELITE epoxy plastics.*

1. Check (a). It minimizes weather and electrical interference along our defense communications lines.
2. Pick (a), (b), and (c)—and epoxy won't harm delicate windings, either.
3. (a) Checks dimensions—it's lightweight and extremely accurate.
4. (a) Epoxy-glass laminate—but epoxy coatings are great on other hulls.
5. (b) They won't slip on this floor's tough, gritty surface.

If you have questions—about epoxies and their potential for your business—please ask us. Why not discuss the matter with a Bakelite Technical Representative? Just write or call any of our offices, or write Bakelite Company, Division of Union Carbide Canada Limited, 40 St. Clair Ave. East, Toronto 7.

UNION CARBIDE

BAKELITE and UNION CARBIDE are trade marks.

For further information mark No. 115 on Readers' Service Card

THE LYMAN LINE OF LEADERS

LYMAN HOFFMANN

BEARINGS

FROM STOCK

- FLAWLESS FINISH
- GREATER CAPACITY
- EXTREME ACCURACY
- HIGH LOAD CAPACITY

Immediate deliveries from complete stocks. Over 100 types in sizes from ¼" bore up.

Hoffman Bearings are recommended by engineers to engineers. The measure of their performance and popularity is reflected in the ever increasing demand.

Write, wire or phone for details regarding your requirements.

LYMAN TUBE AND BEARINGS, LIMITED

MONTREAL TORONTO WINNIPEG
VANCOUVER NEW GLASGOW, N.S.

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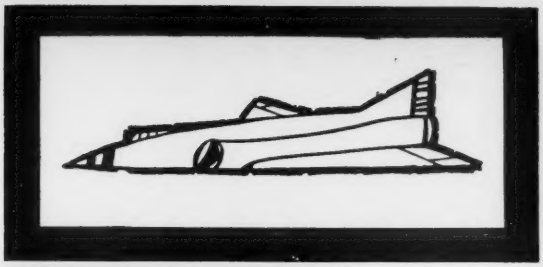
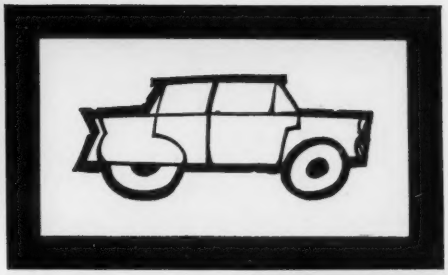
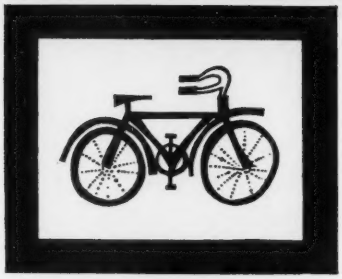
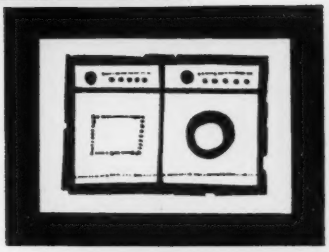


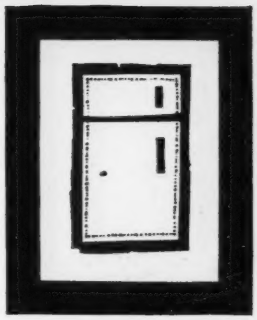


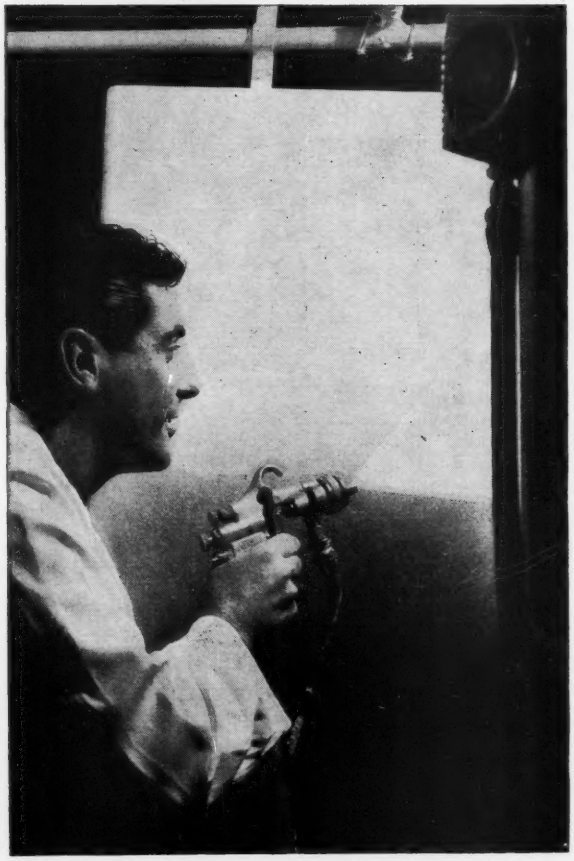




GLIDDEN TAKES AN EXTRA STEP IN THEIR PLANT . . . *To Save You Time in Your Plant!*

QUALITY Glidden PRODUCTS

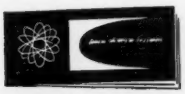




Let us take extra steps for you . . . towards more economical, durable and better finishes! Glidden prepare and supply finishes for thousands of different Canadian products manufactured from coast to coast. Testing and re-testing, repeatedly experimenting with new and better finishes places Glidden research, knowledge and skill in a unique position to assist you. At the Glidden laboratories they have the most modern scientific equipment and facilities with which to work. In many cases developing completely new finishes which have added to the value of the product . . . have cut costs . . . increased production efficiency and product 'life.'

These research services are yours for the asking. Let Glidden put their know-how and creative insight to work . . . to assist you. For further information, please contact our service representative or write direct to us at the address below.

Test-step towards a better finish . . . . in the Glidden Technical Service Department a refrigerator door is test-sprayed under conditions simulating actual production line conditions.



INFORMATION YOU'LL VALUE!
This Booklet outlines all Glidden Technical and Laboratory Services—and how you can profit by them. We will gladly send a free copy to plant executives on request. Just write to:

THE GLIDDEN COMPANY LIMITED

Technical Service Department • 351 Wallace Ave., Toronto, Ont. • 133 Elmslie St., Ville La Salle, Montreal, P.Q.

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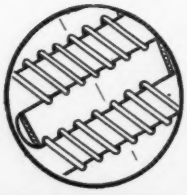
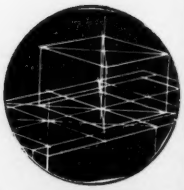
1960 ENGIN SHOW





DESIGN ENGINEERING & ASME CONFERENCE

New York Coliseum, May 23 to 26, 1960

Ideas to spark your thinking. *Applications* to help you create superior products. Knowledge, for better accomplishment. 400 of the nation's most imaginative materials and components manufacturers gathered under one roof to give a plus to your design and development planning. Exhibits are staffed with engineers. Compare first-hand — test — come away with hundreds of new ideas that can influence your product engineering for years ahead. You owe it to yourself to attend.

IDEA EXCHANGE: *The Design Engineering Conference sponsored by the Machine Design Division, American Society of Mechanical Engineers*

The *must* conference of the year for everyone involved in product design, research and development.

For information, write to Clapp & Poliak, Inc., Show Management, 341 Madison Avenue, New York 17, New York.

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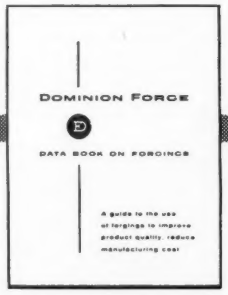
Quality

If forgings are a component,
your product can be better, stronger, safer because of
the big extras in Dominion's forgings


DOMINION FORGE
DATA BOOK ON FORGINGS
A guide to the use of forgings to improve product quality, reduce manufacturing cost

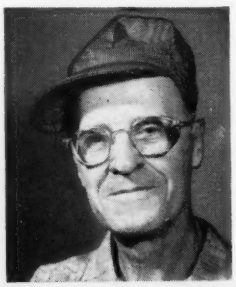
Lower manufacturing costs, a superior product, little if any need for field service and repairs are what you expect — and *get* — when one or more of your product's components are forged.

Something else on which you can count is a better, stronger, safer product if your forgings are from Dominion Forge Limited, one of North America's great forges.

While Dominion's forging and auxiliary facilities cannot be matched for versatility by any other commercial forge on the continent, that's simply a guarantee of service. Dominion's insistence on a standard of quality unsurpassed in its industry is what assures a consistency of quality that is equally unsurpassed. It's a big *extra*. A big extra that adds up to a better, stronger, safer product. *A big extra that costs you nothing extra!*

Your Dominion Forge *forging engineer's* first responsibility is to help you get *all* the extras in forgings Dominion delivers. Put his training and experience to work for you. You'll find it pays.

FREE! Handy informative guide that ought to be at your elbow. Dominion Forge's **DATA BOOK ON FORGINGS,** packed with useful facts, illustrates and describes Dominion's unique facilities. Write for your free copy. No obligation, of course.



DIE SINKER Ernie Berthiaume is one of over 125 members of Dominion Forge's Quarter Century Club—an aggregation of forging experience on which you can count.

DOMINION FORGE LIMITED

MEMBER: DROP FORGING ASSOCIATION

2480 Seminole Street, Walkerville, Ontario, Canada
Telephone: CLearwater 4-7545 • Cable Address: Domforge

For further information mark No. 124 on Readers' Service Card

a pipe dream come true

The people concerned with pipeline transmission of oil and water had long been dissatisfied with the cement-lined steel pipe that was almost exclusively used in this field. What was needed was a pipe that resisted corrosion . . . that could be welded better and more easily . . . that was lighter in weight yet durable . . . that didn't need external wrapping. It seemed to be a mighty tall order until the Aluminum Company of Canada monitored the development of an automatic machine capable of butt welding aluminum piping. Here at last was the answer to a pipe-layer's dream

Only one thing was missing – the means for efficiently joining and welding aluminum pipe lengths *in the field*. This was where A.E.L. came into the picture. The Aluminum Company requested A.E.L. to design a lightweight end-preparation machine and a set of tools which would ensure a satisfactory weld.

A.E.L. has successfully developed a portable *Aluminum Pipe End-Preparation Machine* which can prepare pipe edges in the field where there is a need for shorter than standard lengths or where ends have become damaged. Pipe lengths can now be cut to meet special needs and the ends grooved and shaped right on the job.

Complimentary to the end-preparation machine A.E.L. developed an internal *Pipe Alignment & Back-Up Tool* that permits greater efficiency in pipe laying and gives a better weld than any other known method. This tool expands inside the pipe, holding the adjoining ends close, firm, and in line. After the preliminary weld is made around the new joint, the alignment & back-up tool is contracted and slipped into position at the site of the next join. By the time the machine has completed its weld on the first join, the second join is already prepared for welding. The tool provides back-up for the weld and a heat sink. This method enables contractors to lay more footage of pipe per day while improving the welds and lowering costs.

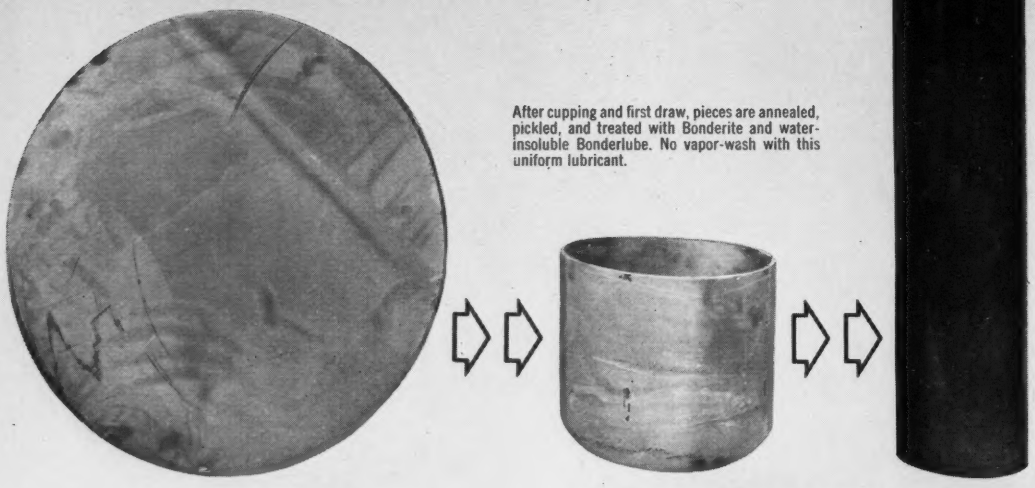
Aviation Electric's diversified skills in research, design, engineering and manufacture are helping solve problems in a wide range of industries. Your enquiries are invited.

AVIATION ELECTRIC
LIMITED
200 Laurentien Blvd., Montreal, P.Q.
Branch Plant: Aviation Electric Pacific Limited,
Vancouver Airport, Vancouver, B.C.

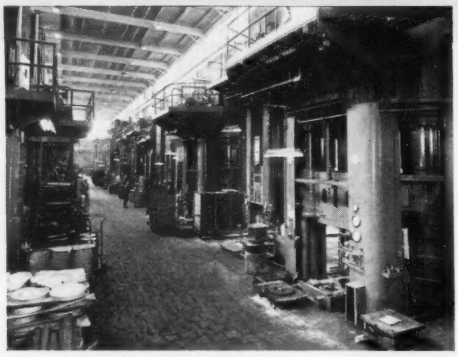
This is the 28-inch blank used in manufacture of large gas cylinders at Norris-Thermador Corporation, Los Angeles, after treatment with Bonderite and Bonderlube. The white, "reacted-on" Bonderlube is a visual check on drawability.

Finish size of cylinder, three operations later, is 8 inches in diameter and 32½ inches long. Only two annealing operations are required from blank to finished size.

After cupping and first draw, pieces are annealed, pickled, and treated with Bonderite and water-insoluble Bonderlube. No vapor-wash with this uniform lubricant.



Increased production at lower costs, real savings with BONDERITE and BONDERLUBE in cold drawing



The press room at Norris-Thermador, Los Angeles. (Photos courtesy Norris-Thermador Corp.)

In heavy drawing operations like those illustrated, high lubricant film strength is vital. BONDERITE, an integral phosphate coating on metal, and BONDERLUBE, chemically combined with the BONDERITE coating, produce an unexcelled, tough film that continues to act as a separating layer even when the surface area worked is increased several times.

This tough integral film moves along with the metal surface. So, you can get greater reductions, use double pass operations and can produce millions of parts without change in your die setup. Results are expanded press productivity and real cost savings.

A further, major source of savings is the reduction in number of necessary process anneals, substantially decreasing handling, pickling and relubricating costs. Even better, with reactive BONDERLUBE, lubricant costs are frequently reduced to a fourth of the former cost.

AIDS ANY SEVERE IRONING OPERATION

If you draw tubing, wire, bumper bars, frame members, motor mounts or do other severe drawing operations on steel plate, BONDERITE and BONDERLUBE will lower forming costs in your plant. Parker's staff of specialists will be sure you get the right combination to raise production and save you money. Write us today.

Parker Rust Proof Company
OF CANADA LTD.
REXDALE BLVD., REXDALE (TORONTO) ONTARIO

BONDERITE corrosion resistant paint base • BONDERITE and BONDERLUBE aids in cold forming of metals • PARCO COMPOUND rust resistant • PARCO LUBRITE—wear resistant for friction surfaces • TROPICAL—heavy duty maintenance paints since 1883

Since 1914—Leader in the field

*Bonderite, Bonderized, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.

For further information mark No. 143 on Readers' Service Card

FAFNIR BEARING NEWS

BEARINGS THAT MAY SOLVE PROBLEMS FOR YOU — PRESENTED BY YOUR FAFNIR DISTRIBUTOR

FOR HEAVY DUTY APPLICATIONS

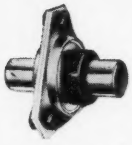
. . . we recommend CO type heavy series cylindrical cartridges. They are available in shaft diameter sizes from ¾" to 3 7/16". **NO. 61101.**

FOR LIGHT DUTY APPLICATIONS

. . . this PB type pillow block gives the advantages of anti-friction bearings at low cost. Available in shaft diameter sizes from ½" to 1¼".

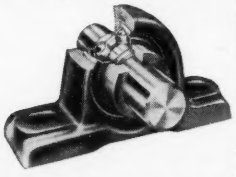
NO. 61102.

SPACE LIMITATIONS?

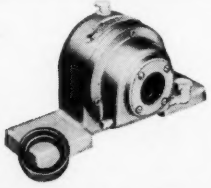


Fafnir Flangette stampings are designed for use where space is a factor. Where it is necessary to cut off one or more sides of the standard flangette stamping, the Triangular Flangette is used. **NO. 61103.**

SHUTS OUT DIRT — This RAK type bearing incorporates Fafnir's Wide Inner Ring Bearings with contact type Plya-Seals which shut out dirt even at very slow speeds. Available in all popular shaft sizes from ½" to 2 15/16".

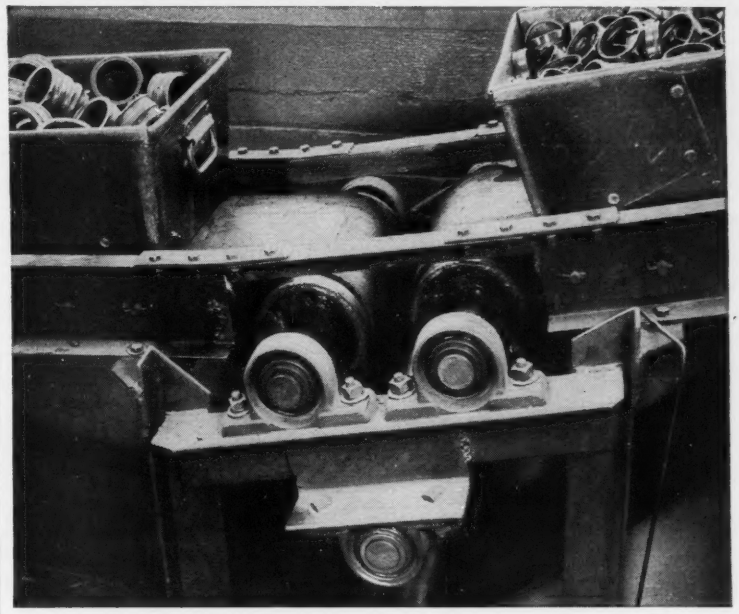


NO. 61104.



WATER COOLED BEARING BEATS THE HEAT

Fafnir SAL type (standard) and SAOL type (heavy series) ball bearing power transmission units, utilizing water-cooled end covers, have been successfully used in close proximity to ovens, fans, etc., with inside temperatures as high as 1,500°F. A small amount of water flowing through a 5/16 in. copper tube keeps the bearing lubricant cool, thus avoiding a breakdown of the oil. **NO. 61105.**



8 YEARS WITHOUT TROUBLE

Fafnir Bearing Quality, Selected For This Hard-working Conveyor System

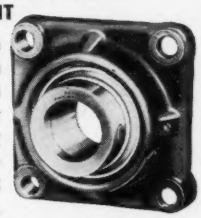
Eight years of operation with no maintenance service except occasional lubrication . . . that is the record of the Fafnir Ball Bearing units installed on the conveyor shown above.

The complete bearing installation on the 3-pulley snubbing device of the conveyor includes six Fafnir LAK Type Pillow Blocks. Four of the blocks are mounted right side up and two, upside down. The conveyor transfers heavily loaded work boxes from one plant floor to another. Like all precision-built Fafnir Industrial Units, LAK Type Pillow Blocks have the famous Fafnir Wide Inner Ring Bearings with self-locking collar . . . easiest of all to install. **NO. 61106.**

60-110R

United Steel
CORPORATION LIMITED
(FAFNIR BEARING DIVISION)
58 PELHAM AVE., TORONTO 9

COMPENSATES FOR SHAFT MISALIGNMENT



This LCJ type flange cartridge incorporates Wide Inner Ring Bearing which compensates for shaft misalignment. Normally used where a shaft meets a flat surface at right angles. Shaft sizes from ½" to 2 7/16". **NO. 61107.**

YOUR LOCAL FAFNIR DISTRIBUTOR IS A QUICK-SERVICE SPECIALIST

Rely on him for prompt delivery of quality Fafnir bearings for your application. You'll find him listed in the Yellow Pages under "Bearings".

—WANT MORE DETAILS?—

Send me literature and prices on:

☐ NO. 61101 ☐ NO. 61102 ☐ NO. 61103 ☐ NO. 61104 ☐ NO. 61105 ☐ NO. 61106 ☐ NO. 61107

NAME.....

TITLE.....

COMPANY.....

ADDRESS.....

CITY OR TOWN.....PROV.....

For further information mark No. 156 on Readers' Service Card

This thinking man thinks for you!

He's a designer at Dominion Fasteners who thinks continually about fastening and assembly operations. His efforts are rewarding for manufacturers across Canada . . . as he is consistently creating new and more efficient fastening methods. Why not turn him loose on your product. He can cut production time, save you money and make your product more competitive.

However, of the more than 8,000 types and sizes of Speed Nut spring tension fasteners now in existence, there may be one already tooled and in production that is perfectly suited for your attachment application.

Like all thinking men, you're a man who wants definite answers. We are prepared and waiting to supply them to you.

DOMINION FASTENERS LIMITED, Dept. A61
HAMILTON, ONT. Sales Branches: Toronto, Montreal
a Geo. A. Tinnerman *corporation*

Rush me complete information on how Speed Nuts can save me time and money, and improve my product.

NAME_____

COMPANY_____

ADDRESS_____

WE MANUFACTURE_____

For further information mark No. 123 on Readers' Service Card

big trout or small muskie?

Building machinery is our business but when you talk about a "big" one, we're in the same league as the fisherman. What might be a whale of a machine to one customer could be pickerel-size to another.

But it really doesn't matter what size machine you require. Canada Iron builds them big or small. And while their size may vary they are all letter-perfect. The most efficient machinery for whatever job it is intended. Here's why:

● Two modern plants at Trois Rivieres and Toronto where you'll find the latest, most efficient machinery-building equipment ● An engineering staff of knowledgeable technicians. A research and development program that assures you all the benefits of the latest improvements in the field of metallurgy ● A production staff who build "by the book"! Never short cut quality and are proud of their reliability ● A customer list of satisfied North American manufacturers for whom we have built machinery of every description.

Canada Iron
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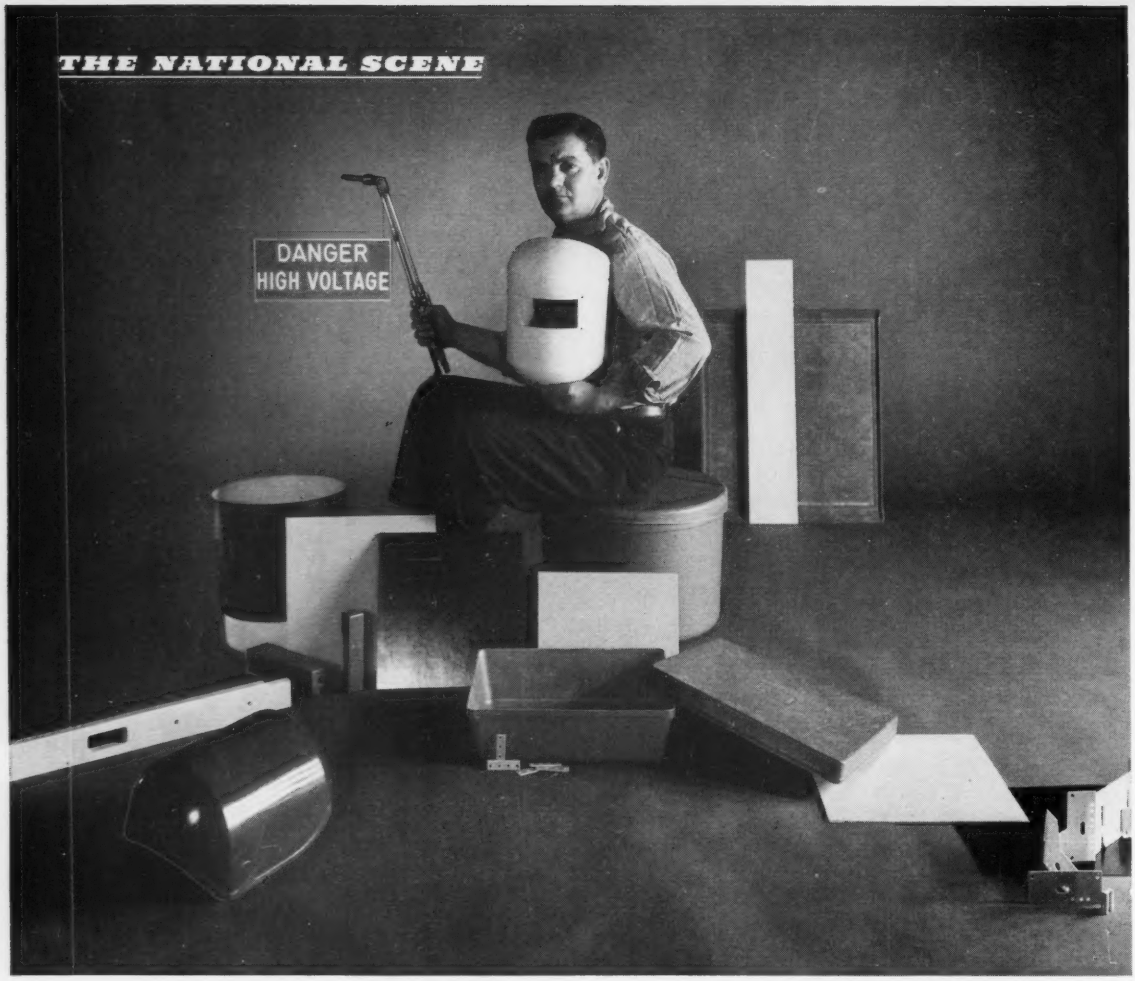

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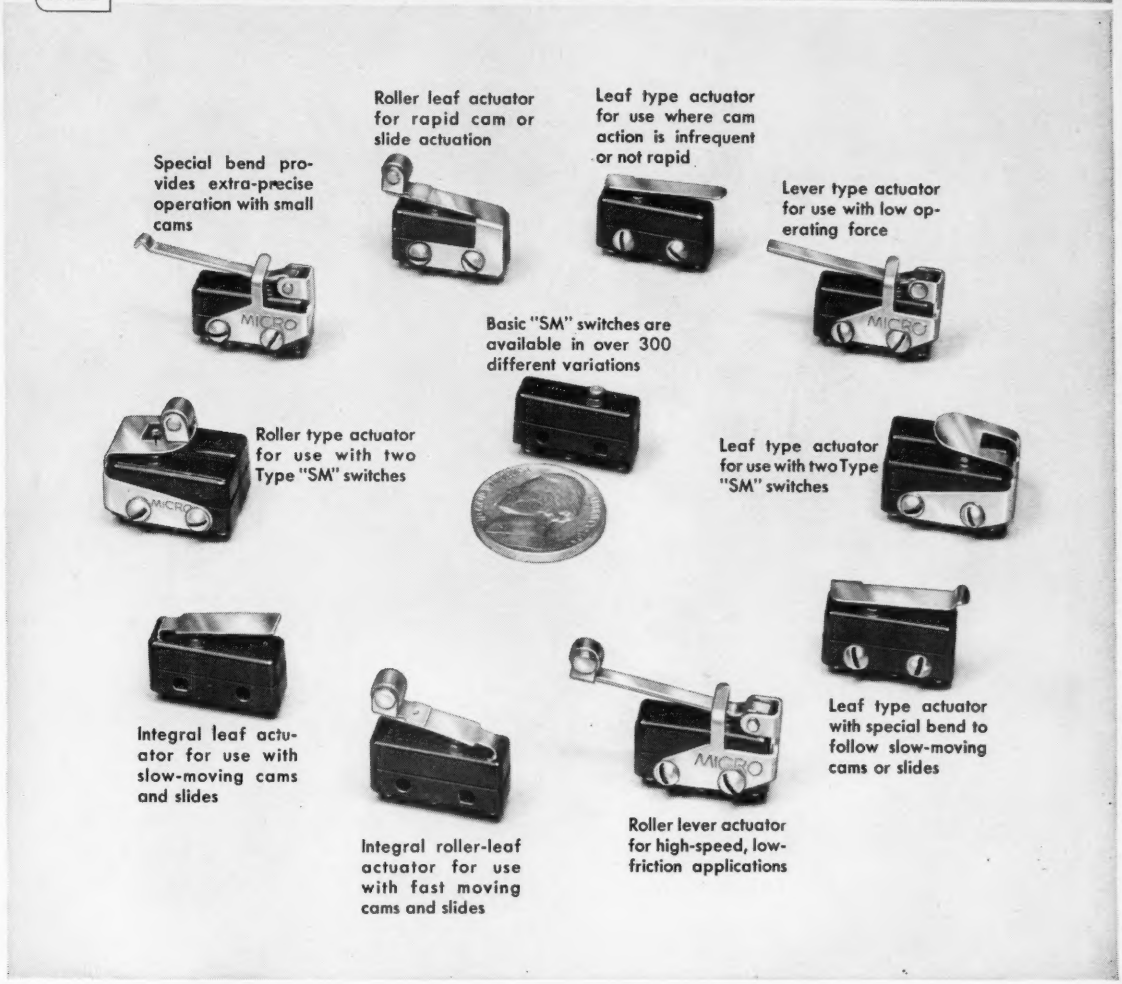
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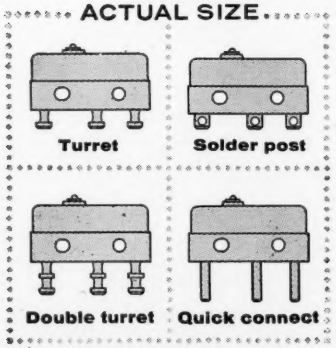

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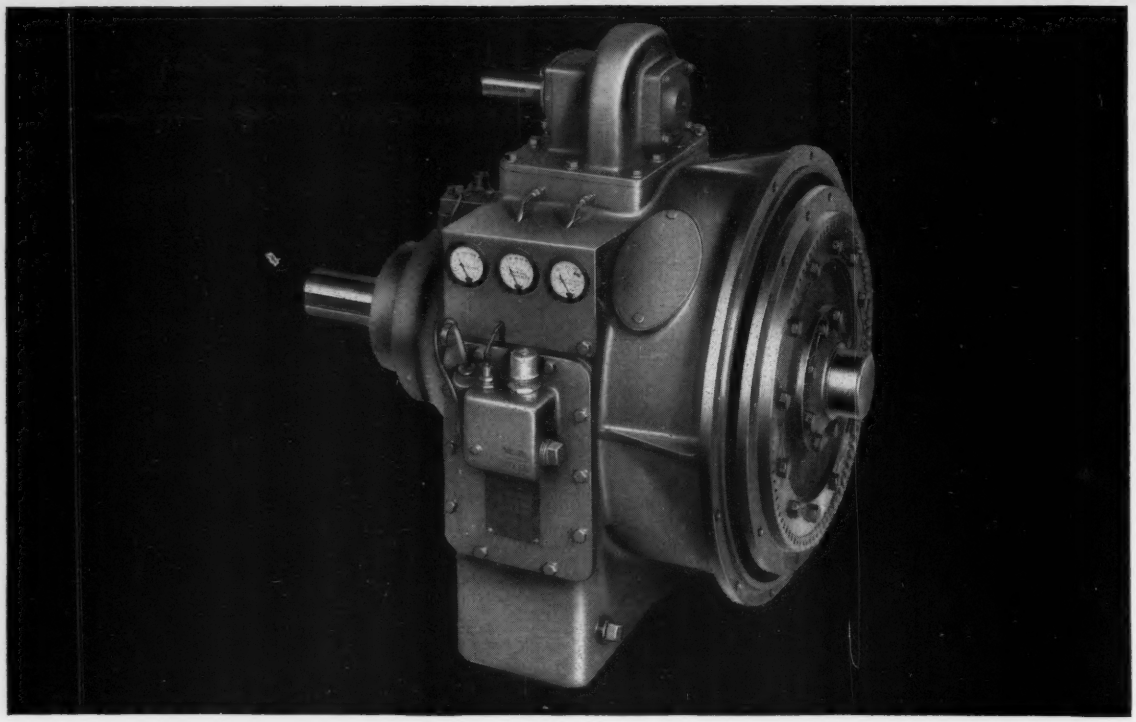

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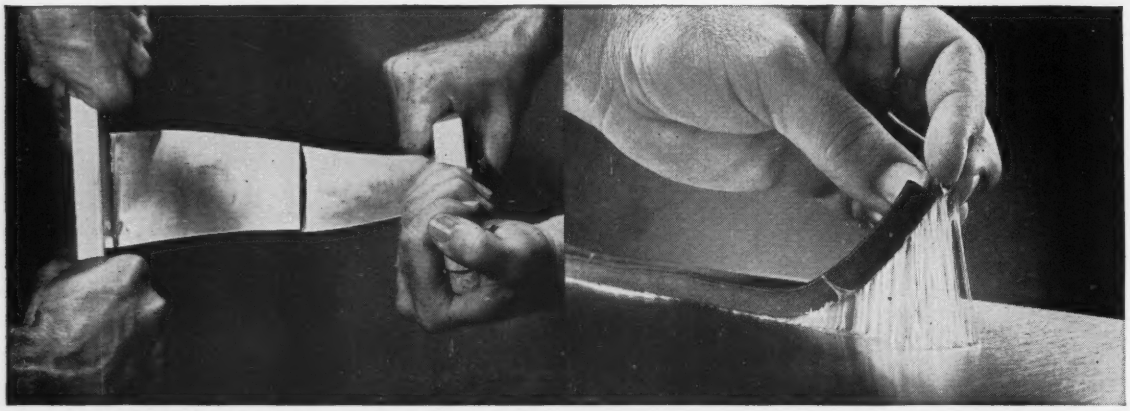

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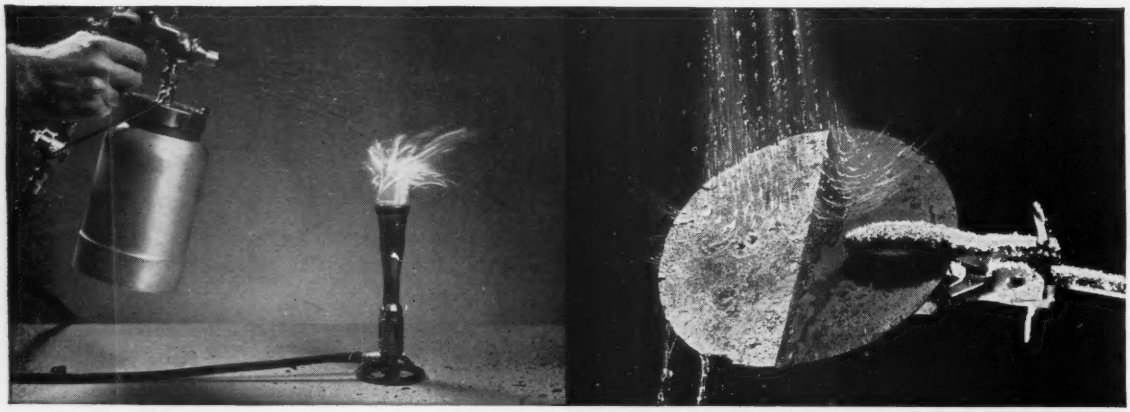

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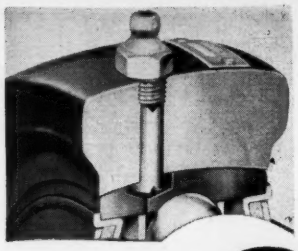

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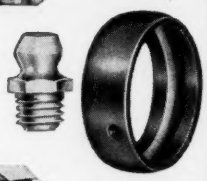

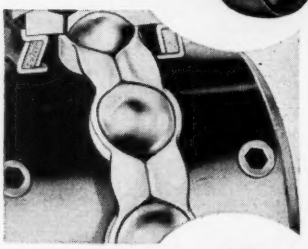

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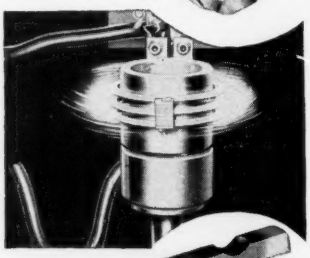

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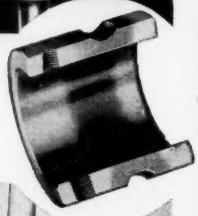

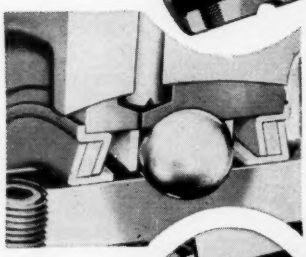

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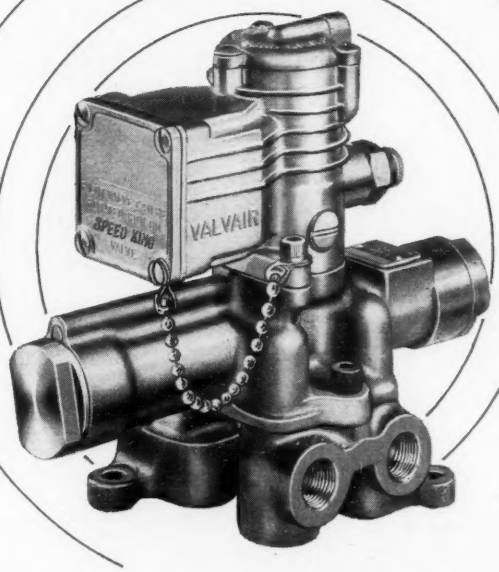

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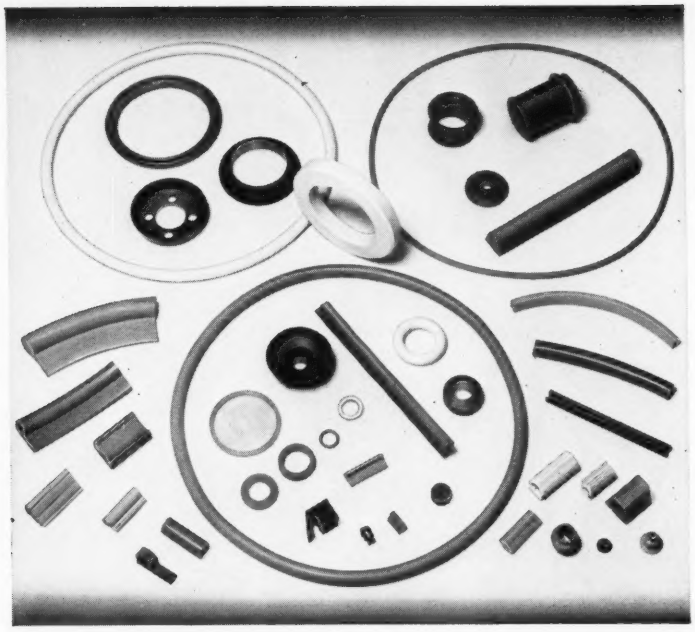

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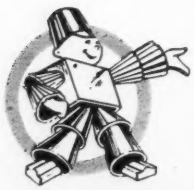

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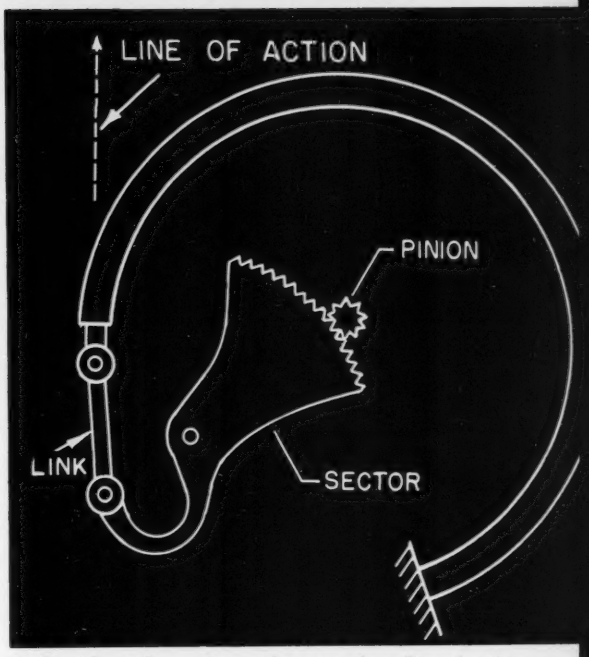
Second of three part series

Bourdon tubes designed as curved beams

G. Kardos, P.Eng.



1. Bourdon tube — free end moves along line of action.

Treating deflection of Bourdon tube as beam with external loading simplifies preliminary calculations — final design obtained by experiment

Bourdon tubes deflect in two ways, first due to internal pressure, and second as a curved beam due to external load. A previous article (October 1959) covered free deflection of the Bourdon tube under internal pressure. This article treats deflection of the Bourdon tube with external load.

Except for a few special cases a Bourdon tube indicates pressure by deflecting at its free end and driving some form of mechanism. Fig. 1 shows a typical Bourdon tube and Bourdon tube mechanism. The free end of the Bourdon tube under internal pressure moves along the line of action and transmits this motion through the link and sector to the pinion as rotary motion. The angular rotation of the pinion is proportional to the linear motion of the Bourdon tube within the limits of the translating mechanism. The pinion may be attached to a pointer having an anti backlash spring, a potentiometer, a synchro or some other indicator. These indicators, either because of their spring action or due to friction, produce a restrictive load through the linkage to the Bourdon tube. This restrictive load causes an additional deflection of the tube end, which deflection may increase or decrease the total deflection of the tube free end depending on the direction of the load.

The average Bourdon tube has a free end deflection for full range of approximately .100 inches, therefore even small deflections due to reactive load may be a substantial part of the total deflection.

For the purposes of analysis we may consider the Bourdon tube to be a curved beam fixed at one end with a concentrated load at the free end. Fig. 2 shows a tube of curvature R, included angle ϕ_0 acted upon by an external load F at angle α_F. The moment of inertia of the tube cross section is I, and E is the Young's modulus for the tube material.

Strain Energy Calculations

The deflection of curved beams is usually treated by means of strain energy methods. Thus the deflection in the direction of the load is the total strain energy in the beam divided by the force.

$$\Delta y = \frac{R}{EI}\int_0^{\phi_0} M\frac{\partial M}{\partial F}d\phi$$

$$\Delta x = \frac{R}{EI}\int_0^{\phi_0} M\frac{\partial M}{\partial Q}d\phi$$

The deflection of the free end of the beam at right angles to the load Δx is the total strain energy in the beam divided by an imaginary load Q of magnitude zero in the X direction.

The derivation of the above formulas can be found in any standard text on strength of materials.

In the above formulae, M is the bending moment on an element of the beam. By examination it can be seen that M can be expressed as a function of

continued

Mr. G. Kardos, author of this article, is engineering supervisor with Aviation Electric Limited, Montreal, Que.

the angle ϕ_0, the curvature R, the load angle α_F and the load F.

Carrying out the integration, the equations for the deflection become

$$\Delta y = \frac{FR^3}{EI}\zeta_y(\alpha_F, \phi_0)$$

$$\Delta x = \frac{FR^3}{EI}\zeta_x(\alpha_F, \phi_0)$$

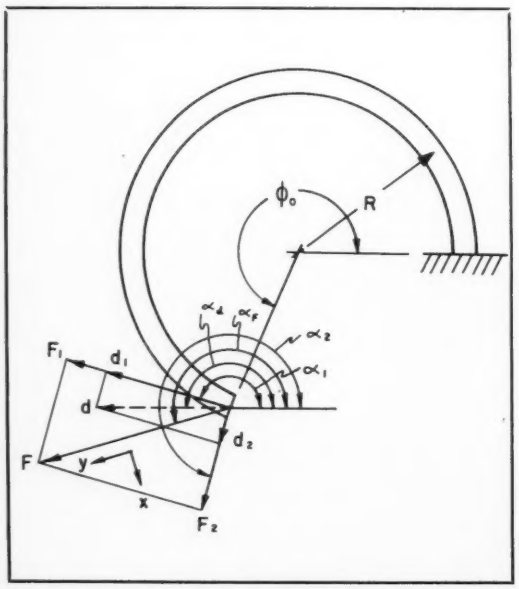
where ζ_y and ζ_x are functions of the angles α_F and ϕ_0.

Thus by using the above relationship the total deflection and the direction of the deflection of the free end of a curved beam under any load at the tip can be calculated. The above method is satisfactory if only a few specific evaluations are to be made, but where a number of calculations have to be made, to arrive at the best relationship some faster method is desirable.

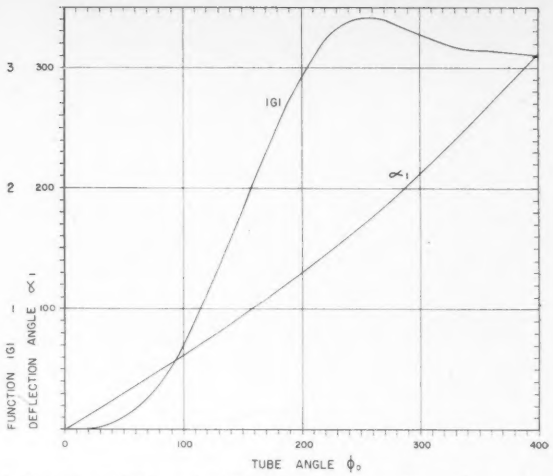
Simplified Calculations

To simplify Bourdon tube calculations F. B. Jennings has taken advantage of the fact that there are two "principle" directions, that is, directions of load application where the net tube deflection is in line with the applied load. These principle directions are α_1 and α_2. Thus if any load F at angle α_F is resolved into two forces F_1 at angle α_1 and force F_2 at angle α_2 the deflections due to F_1 and F_2 will be in line with the loads and the total deflection "d" will be the vector sum of these deflections.

Jennings, using complex variable, found the following relationship:



2. Nomenclature and diagram used in design calculations



3. Graph of /G/ and deflection plotted against tube angle.

$$d_1 = \frac{F_1R^3}{EI}\zeta_1$$

$$d_2 = \frac{F_2R^3}{EI}\zeta_2$$

where

$$\zeta_1 = \phi_0 - \sin\phi_0 + /G/$$

$$\zeta_2 = \phi_0 - \sin\phi_0 - /G/$$

$$\alpha_1 = \frac{1}{2}\text{arc } G$$

$$\alpha_2 = \frac{1}{2}\text{arc } G + 90°$$

$$G = /G/\, e^{j\text{arc}G} = -\frac{1}{2}\phi_0 e^{j2\phi_0} - \frac{3}{4}je^{j2\phi_0} + je^{j\phi_0} - \frac{1}{4}j$$

For convenience the values of α_1 and $/G/$ are plotted against ϕ_0 in fig. 3 for beams of 1 turn or less.

Several things are worthy of note here. Angles α_1 and α_2 are orthagonal therefore the resultants of the motions can be easily computed. Angle α_1 is approximately the same as the direction of tip travel Θ for Bourdon tubes subject to internal pressure. The beam deflects much less for loads in the α_2 direction than for the same load in the α_1 direction, i.e., it is stiffer.

Hollow Section Beam

The above analysis applies to all curved beams, but a curved tube in bending does not react in exactly the same way as an equivalent solid beam. When a curved beam of hollow section is subjected to a bending moment the tube tends to flatten and a re-distribution of internal stress takes place, therefore the stress and strain is not as would be predicted by elementary theory of bending. The net effect of the flattening and the re-arrangement

of stress is the same as if the moment of inertia of the cross section were reduced. As a result a curved tube in bending will be more flexible than curved solid bar of equivalent moment of inertia and curvature. This ratio is called the flexibility ratio f_2 and is dependent on the geometry of the tube.

The early work was concerned with the flexibility ratio of round tubes for piping calculations. Von Karman has given the flexibility ratio of round tubes as

$$f_2 = 1 - \frac{9}{10 + 12\lambda^2}$$

$$\lambda = \frac{Rh}{a^2}$$

R = Curvature of tube (fig. 2)
h = Wall thickness
a = Radius of tube cross section

Dr. Wuest, who developed the formula for deflection of flat oval Bourdon tubes using the same approximate methods, worked out the flexibility ratio for the flat oval Bourdon tubes (fig. 4). The values for the flexibility ratio are plotted in fig. 5 with respect to axis ratio and λ. The geometric term λ is the same as for round tubes except that half the major axis of the cross section is used instead of the radius.

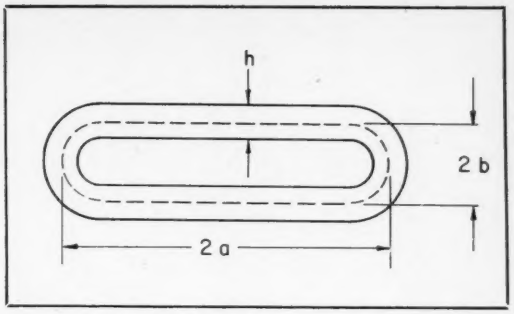
We can now express the deflection of a curved Bourdon tube under external load as

$$d_1 = \frac{F_1 R^3}{f_2 EI}\,\zeta_1$$

$$d_2 = \frac{F_2 R^3}{f_2 EI}\,\zeta_2$$

If we have a Bourdon tube driving a mechanism we can express the total deflection of the free end of the Bourdon tube due to superposition as the vector sum of the deflection due to internal pressure "l" and the deflection due to the resistive load of the mechanism "d".

$$\vec{m} = \vec{l} + \vec{d}$$

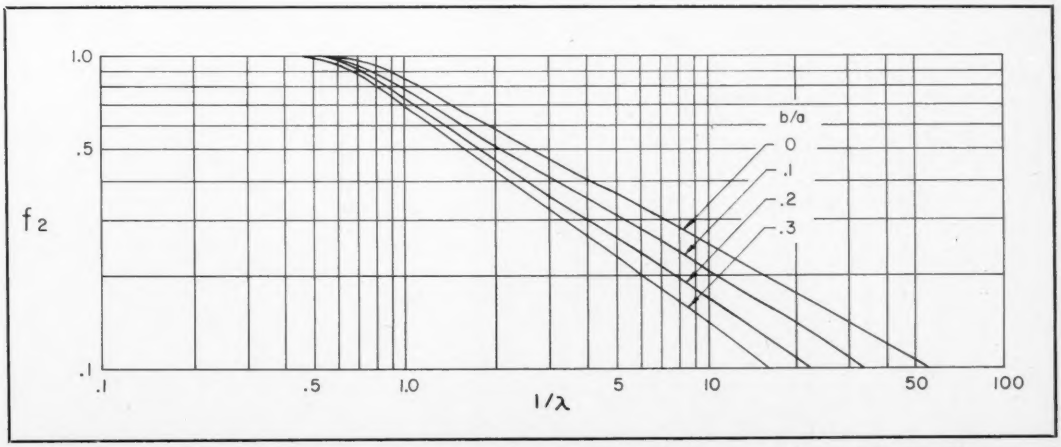


4. Flat oval Bourdon tubes present special problems.

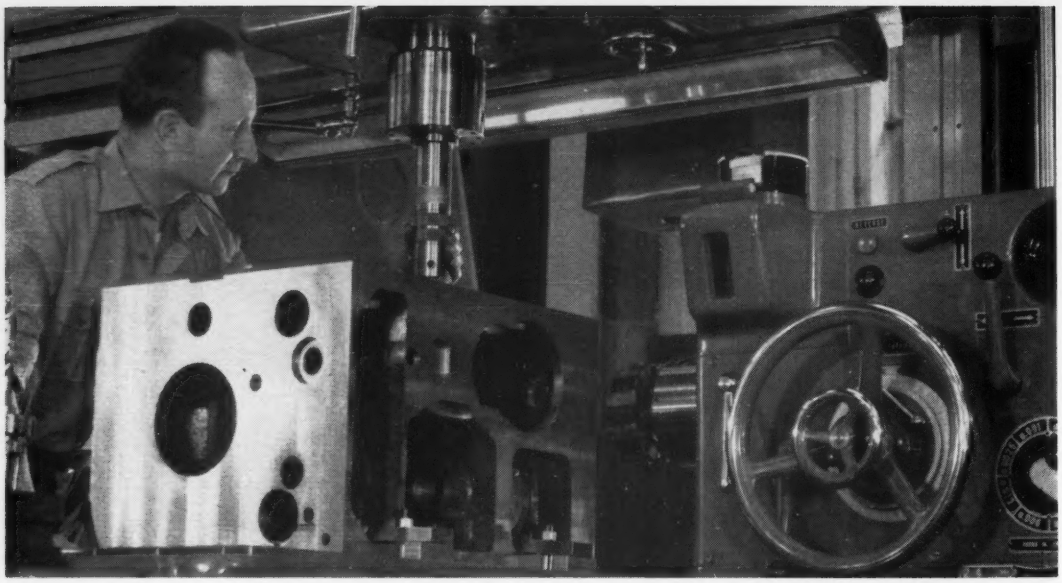
The above relationship can also be used to determine the force available for actuating a mechanism from a Bourdon tube due to pressure, by calculating the deflection "l" at the required pressure and determining the force necessary to return the tube to its position before deflection, i.e., the force which will give an equal and opposite deflection. This force is now the available torque.

We now have all the information needed to evaluate our Bourdon tube in relationship to its mechanism. We can determine the allowable resistance load of our driven mechanism from the torque available in the Bourdon tube. We can determine the magnification required in our mechanism by calculating the total deflection due to both pressure and resistive load. We can evaluate our mechanism and Bourdon tube to ensure that linearity with pressure is obtained.

As with free deflection of Bourdon tubes due to pressure it must be noted that the above are approximate values and are most useful in the early stages of design when basic parameters are being evaluated. The final results can only be obtained by experimentation. But the results given here permit us to analyse the action and remove it from the field of trial and error and make the design of Bourdon tube instruments semi-analytical. ★



5. Values for flexibility ratio of flat oval Bourdon tubes (see figure 4 above) as calculated by Dr. Wuest.



A tool designer looks at jig boring

Some toolroom tips on accuracy, dimensioning and types of machines

Michael D. Stephenson

The problem of accurately locating holes one with another is a major preoccupation in every toolroom, be it large or small. Every tool engineering drafting room is constantly engaged in the calculations necessitated by this important process, since practically every toolmaking job requires one or more holes to be accurately positioned and bored.

Before the advent of special jig boring machines, and even today where extreme accuracy is not required and a jig borer is not available, the methods of obtaining correct hole location are roughly divided into three groups known as layout, wiggling and buttoning.

Accuracy without a jig borer

Assume some holes are to be bored in a flat plate. The first operation, with most methods, is to square up the adjacent edges. Lines may now be marked out by one of several methods to obtain the required hole centres.

A simple operation and one requiring the minimum of equipment is that of scribing the lines by means of an ordinary combination square and scriber. The accuracy that might be expected would be, perhaps, ± .005 in. A surface gauge may be set more accurately, and if used may give a result to about ± .003 in. The height gauge, however, is the most convenient and most frequently employed. The vernier scale permits direct readings to a thousandth of an inch and estimations to half a thousandth.

In a jig plate where accuracy is not to close limits, after very careful centre punching and checking the impression with a magnifying glass, the holes may be carefully drilled. If the work is done unhurriedly, the finished hole centres may be as close as ± .002 in.

Where greater accuracy is required a very light and therefore more accurate centre punch can be used, and the process known as "wiggling" employed. The operation is performed in the following manner. After marking out, the plate to be drilled is clamped on a lathe face plate. The wiggler is mounted between one of the centre punch marks and the tailstock centre. The job is then tapped into such a position as to obtain a zero reading on the indicator gauge when the face plate is slowly rotated. Rough drilling and single point boring may now commence on this hole. It will be appreciated that the entire process must be repeated for each hole required.

A third method and by far the most accurate is that of "buttoning." If done carefully this method is capable of giving an accuracy of ± .0005 in. but the process is long and tedious.

Toolmakers' buttons are nothing more than accurately ground bushings finished to convenient outside diameters of say .3000 in., .4000 in., .5000 in., etc., and about ⅝ in. long. They are clamped by means of a suitable bolt and washer.

To prepare a hole for buttoning, the hole centres, which have been previously marked out, are drilled

Six methods of dimensioning . . . which do you use?

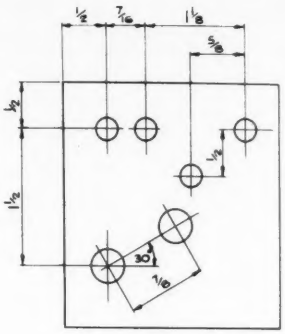


Fig. 1

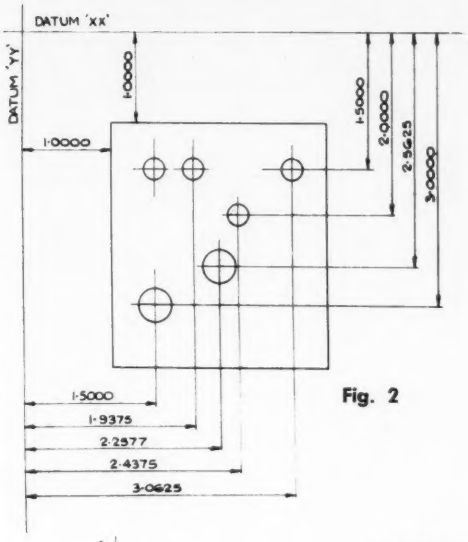


Fig. 2

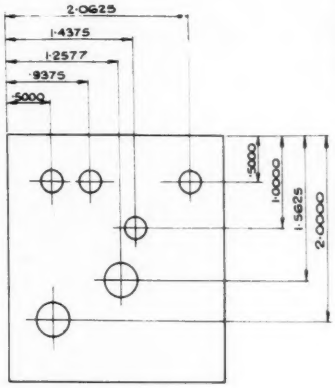


Fig. 3

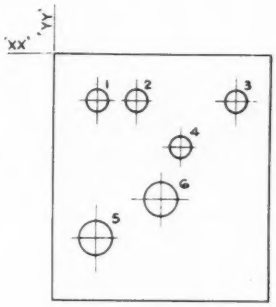


Fig. 4

BORING CHART		
HOLE N°	'XX'	'YY'
1	·5000	·5000
2	·5000	·9375
3	·5000	2·0625
4	1·0000	1·4375
5	2·0000	·5000
6	1·5625	1·2577

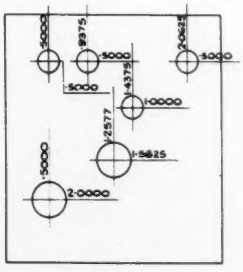


Fig. 5

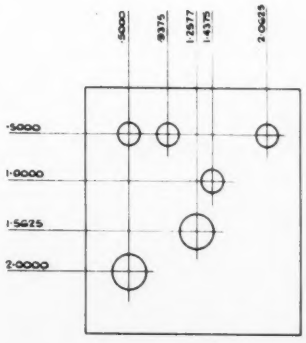


Fig. 6

continued ▶

and tapped to take the button clamping screws. One button is mounted at a time and by using a surface plate and height gauge each is adjusted by tapping until both co-ordinates coincide with the correct value. The patience required is emphasized by the fact that the button must be correctly aligned in two directions.

When the button is set, it is clamped, checked and the job mounted roughly on the face plate. The job is now tapped into its correct position by setting the button with an indicator gauge, similar to the method used for wiggling. After this operation is completed the hole may be bored.

Button boring in place of jig boring is a practical operation only on flat plates or fairly symmetrical box fabrications of reasonable proportions. It is obviously unsuitable for very long plates, brackets and castings which cannot easily be swung in a lathe. In the case of larger work the job must be held stationary and the tool made to revolve. Accurate results may sometimes be obtained using a vertical milling machine or even a horizontal type having a vertical attachment.

Typical jig boring machines

Every type of jig boring machine is fundamentally a special purpose machine designed solely to perform accurate single point boring, using co-ordinate location.

The machine must be capable of boring to the very close limits required for this class of work and the location of table and/or tool must be similarly accurate and preferably performed by direct measurement.

Three types of machine are in current use, the vertical, bridge and the horizontal types.

It would appear that one of the very first attempts at building a boring machine especially for accurately boring jigs was a horizoztal type built in 1896. For years little further progress was made with this machine, and even as late as 1917 Joseph V. Woodworth in his book, "American Toolmaking and Interchangeable Manufacture," stated that, "There is only one method of locating bushing holes in small and medium sized jigs accurately and expeditiously . . . and is known as the button method."

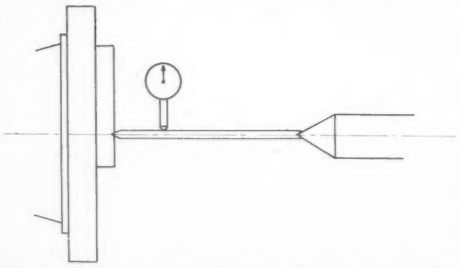


Fig. 7. Wiggling, or hole positioning in lathe.

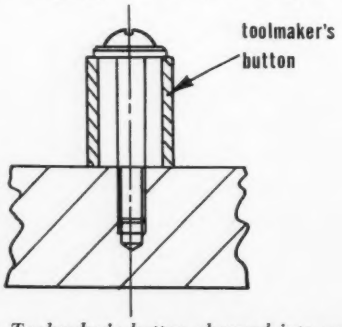


Fig 8. Toolmaker's button clamped into position.

Shortly after this book appeared, the Pratt & Whitney Company of Hartford, Conn., built the first example of the vertical type in August, 1917, and in 1920 in Geneva, Switzerland, the Societe Genevoise d'Instruments De Physique (S.I.P.) produced the prototype of their bridge design.

The S.I.P. machine was a logical development of the pointing machine used during World War I in the watchmaking industry. This pointing machine was designed to mark out in rectangular or polar co-ordinates the master jigs used to drill the top and bottom plates of watches. These were originally small bench machines, but when the prototype jig borer appeared it had a capacity of 24 x 18 ins. and was capable of drilling 1¼ ins. diameter holes in cast iron to an accuracy of ± .005 in. A modern three co-ordinate machine having a table 37 x 28 ins., has a guaranteed accuracy of .0001 in. and is capable of accurate heavy milling operations as well as the performance of its normal duty of precision boring.

As already noted, the horizontal borer was the earliest contender in the jig boring field but it was not marketed. As a consequence, it lost considerable ground to its contemporaries.

However during recent years the several inherent advantages of the horizontal jig borer have been more fully recognized, and this type of machine has now become firmly established in industry.

The horizontal machine can never replace the vertical for the multitude of operations on flat jig plates and similar parts. The bridge type, with its vertical spindle adjustment, might also claim to be superior for box type jigs and castings, where boring is normal to one surface.

Where operations are to be performed on several sides of complicated fabrications or castings, it becomes economic to use the versatile horizontal style, preferably with built-in rotary table. By this means several holes in several faces may be bored at one setting with the part conveniently clamped on the table. Contrary to popular thought, error is not introduced by overhang of the horizontal spindle. Work may be fed into the tool thus creating a desirable constant cutting condition.

A jig borer is an important adjunct to any facility and accordingly the merits and limitations of the equipment available should be thoroughly investigated.

Dimensioning for the jig borer

Space does not permit of a detailed description of the various mechanical and optical methods used to obtain precision movements of the table or spindle of the many makes of jig borers that are now available. It will merely be assumed that elaborate methods are employed in order to obtain the necessary degree of accuracy, and that in all cases the co-ordinate system of location is used. This latter condition means that in order to obtain any given hole centre, two movements must be made at right angles to one another. In the case of the horizontal and vertical type machines, two table movements are required to bring the work accurately to the fixed spindle. The bridge type machine requires one table movement and one spindle move-

ment, again traversed at right angles one to the other.

For the benefit of those unfamiliar with the co-ordinate system, attention will be directed to the diagrams on page 45. In (1) is seen a flat plate which is dimensioned normally from centre lines; (2) shows the same plate dimensioned from two rectangular ordinates XX and YY, while at (3) the more usual method of co-ordinate dimensioning is shown, where the co-ordinates are assumed to coincide with the edges of the plate.

It will be readily agreed that in (1) the plate is dimensioned in a logical manner such as any draftsman might be expected to apply. This method, although perfectly in order, is of little value to the jig boring machinist. The operator could possibly undertake the boring of the smaller sized holes, since these are arranged in a fairly simple manner, but even to bore these effectively would entail the use of simple arithmetic with the attendant danger of errors. For the larger sized hole positioned at 30°, it would be impossible to bore this directly from the drawing, due to the lack of suitable dimensions.

It is not suggested that the product designer should consider the specialist requirements of the jig borer and dimension his drawings accordingly. In every organization of any size it falls upon the tool draftsman to convert the theory of the part drawing into a form more suitable to practical toolroom methods. In effect, the tool designer must scan every part drawing and bring it into line with practical procedure wherever necessary.

Where the workpiece is of an irregular shape and co-ordinates cannot be taken from two edges at right angles location may be taken either from one convenient hole or from reference datum lines.

Dimensioning for quick reference

The tool designer, having calculated suitable dimensions for the use of the jig borer, may well feel that there exists some latitude in choice of methods of presentation. Obviously the dimensions should be laid out in a clear and concise manner for easy working and avoidance of possible mistakes. Some alternative methods of dimensioning may therefore prove of interest.

It will be appreciated that as the number of holes in the plate increases, a system such as shown in fig. 3 can become over-complicated by reason of the large number of co-ordinate lines necessary.

One suggestion to eliminate this difficulty is shown in fig. 4. This form possesses the advantage of a clean looking drawing but may be found confusing, since dimensions are not taken directly to the holes, but the values have to be found from the chart by a system of cross reference.

The method shown in fig. 5 is considered better. Each hole is provided with its two relevant dimensions. These dimensions are placed close to the hole to which they refer. When a large number of holes are present this layout may become confusd, with the consequent chance of one or more holes being missed. With this disadvantage in mind, the system seen in fig. 6 is sometimes used. For this system it is claimed that it becomes a relatively simple matter to place a check by each dimension after the hole to which it refers has been bored. Even this is not ideal since operations on holes are not usually performed according to the sequence of the dimensions but rather from the size of the holes.

However, as often happens in practical tool engineering, the designer is left with little choice as to methods of dimensioning and must follow the system adopted by his particular company. Where a choice does exist or where an old system is being overhauled or a jig borer is being installed for the first time, a little thought directed to the best dimensional system to adopt should pay off in time saved and work spoiled. ★

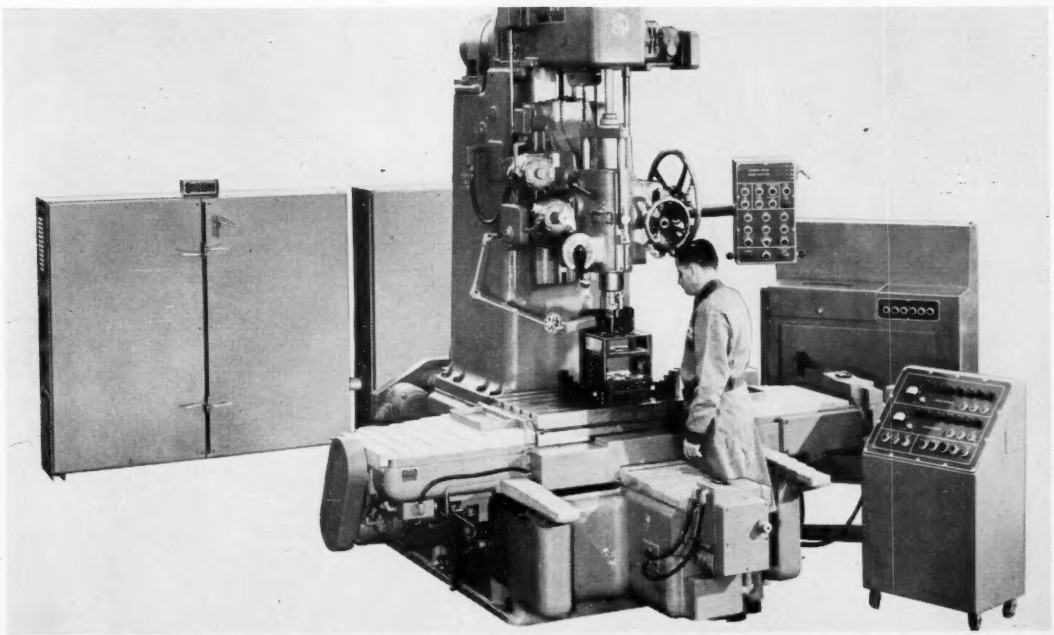


Fig 9. A modern version of the vertical type machine is illustrated here. The unit has numerical control.

Although screws and bolts are designed chiefly for axial loads, they are often subjected to bending or shearing stresses.

Where this occurs, the design must include some means of overcoming these stresses. Four simple solutions are outlined by the author.

Bolt bending stresses

Federico Strasser

Screws, or bolts are designed chiefly for resisting longitudinal (co-axial) loads. They are subjected normally to tension or to compression, and to torsion when fastened under load. However, it happens quite often that screws are subjected also to additional bending or shearing forces which could cause permanent or temporary deformations in the screws and a change in the relative position of the components joined by them. (fig. 1)

For those cases where the effects of such information are not permissible, some preventive means must be included, which will protect the screws from the additional stress.

There are four basic solutions for this problem: (a) dowel pins, (b) dowel bolts, (c) bushings, (d) intermeshing (component shapes).

Dowel pins

Dowel pins may be employed in three different designs: cylindrical (smooth), tapered and grooved.

Straight, cylindrical dowel pins are inexpensive, accurate, reliable, easy to make and/or to purchase commercially. They are preferred where the joint is semipermanent, i.e. where the components are often assembled and disassembled (fig. 2).

Tapered dowel pins are employed preferably in temporary assemblies which are more often disassembled (fig. 3). They need less care in machining and offer very high accuracy of alignment and strong locking action.

If the dowel pin, either straight cylindrical or tapered, is put into a blind hole in one of the components, then at the free and there must be a threaded overreaching portion, designed for a nut by which the pin may be easily extracted from the hole (fig. 4).

Finally, grooved cylindrical pins are used in permanent joints where disassembly is rarely, if ever, required (fig. 5). They are cylindrical pins where one or more (max. three) grooves are formed, either on the entire length or at one end, or in the middle. Sometimes, the grooved pin is provided with a formed head.

Dowel bolts

Dowel bolts are used where the space is restricted and there is no place available for both a separate screw and a pin. They are composed of two parts (in addition to the head): an aligning smooth shaft and a threaded fastening point. Of course, the thread OD is decidedly smaller than the shaft diameter. They are usually made from alloy steel, often are hardened for increased strength, ground and sometimes lapped for greater accuracy of alignment. The corresponding holes must be a correct sliding fit to the shaft, exactly as is the case with dowel pins.

Dowel bolts are used in two general designs: with cylindrical shaft (and head) (fig. 6) and tapered (headless) shaft (fig. 7).

The tapered dowel bolts — analogues to the tapered dowel pins — offer the advantage of very high strength, so they readily resist considerable intermittent and reversing loads.

The cylindrical design is more commonly used; there are very good makes to be found in commerce.

Bushings

Bushings allow the use of ordinary, common screws, because the bushings take care of the bending or shearing load. The dimensions of such accessories are easily determined: OD is a sliding fit to the holes in the components, ID is a clearance hole for the fastening screw.

Also bushings, which are always cylindrical, may be employed in two basic designs: integral (fig. 8) or longitudinally split (fig. 9). Both types may be either full-length (as in figs. 8 & 9), or only partial (rings) as in figs. 10 & 11.

Split bushings, if made from hardened steel, offer the advantage of not requiring holes (in the components) with too close tolerances; it is enough to simply use standard drills. However, due to their elasticity, under high loads, they deform somewhat and so the alignment between the two components is not maintained so per-

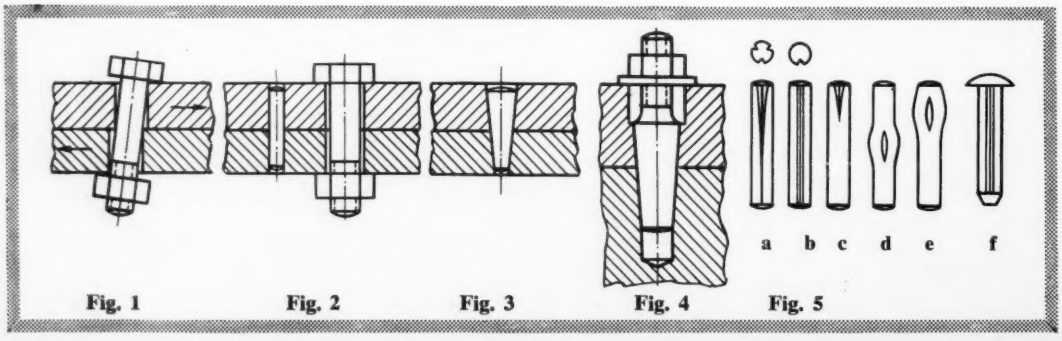


Fig. 1 Fig. 2 Fig. 3 Fig. 4 Fig. 5

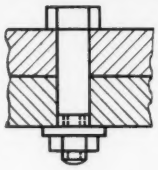


Fig. 6

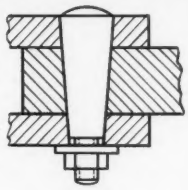


Fig. 7

fectly as with the other means.

The design with ring-bushings (fig. 11) is better than the others, because, while accomplishing the same load relieving function as the full-length bushing, it has a lesser weakening effect on the components to be joined. This compensates for the disadvantage of the more careful machining needed, since blind holes cost more to create than through holes.

Interlacing components

The last solution, which is the best, i.e. interlacing components, also allows for the use of ordinary screws; however, it demands more or less substantial machining (or otherwise processing) of the components. In fact, in these cases, it is rather the shape of the components which takes care of the bending or shearing load. From the quite large variety of deisgn possibilities, here are a few typical examples.

If the load is unidirectional (e.g. gravity) it is enough to make one of the components (of course, the right one!) with a proper shoulder which is then caught by a corner of the matching component (fig. 12).

Sometimes, the two components must be flush at the top. Then the shoulder is machined in both components (fig. 13). The shoulders must be matching mirror-images.

If the bending load is bi-directional, a tongue may be machined in one of the components and a matching slot in the other (fig. 14).

Finally, in the case of components made from sheet metal or plate, if the bending (or shearing) loads are comparatively low, the expensive machined tongue and slot combination may be substituted by simple partially extruded hubs which match punched or drilled holes in the corresponding counterparts (fig. 15).

The same arrangement may be made also in the case of die-cast or molded plastic parts where the necessary hubs and respective holes can be incorporated in the component design and automatically produced during the corresponding casting or molding operation. ★

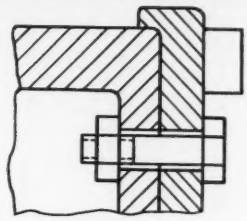


Fig. 12

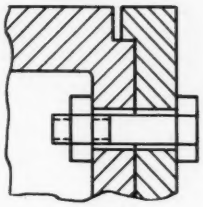


Fig. 13

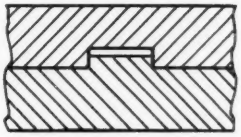


Fig. 14

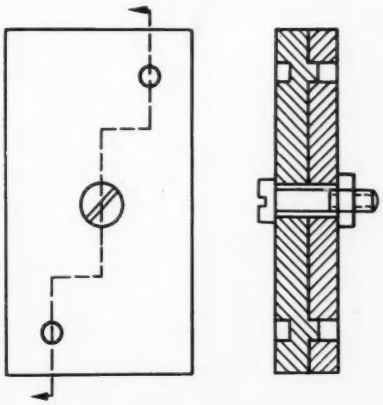


Fig. 15

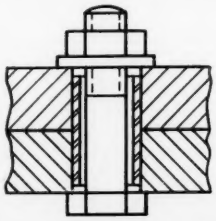


Fig. 8

Fig. 9

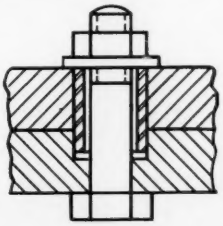


Fig. 10

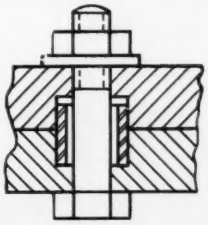
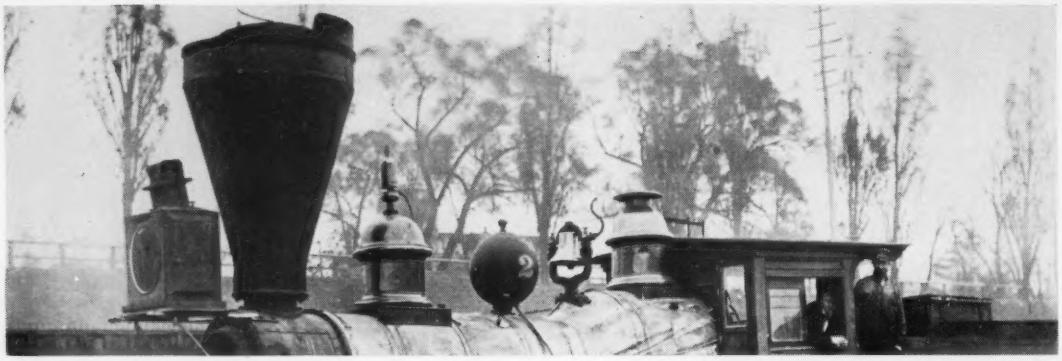
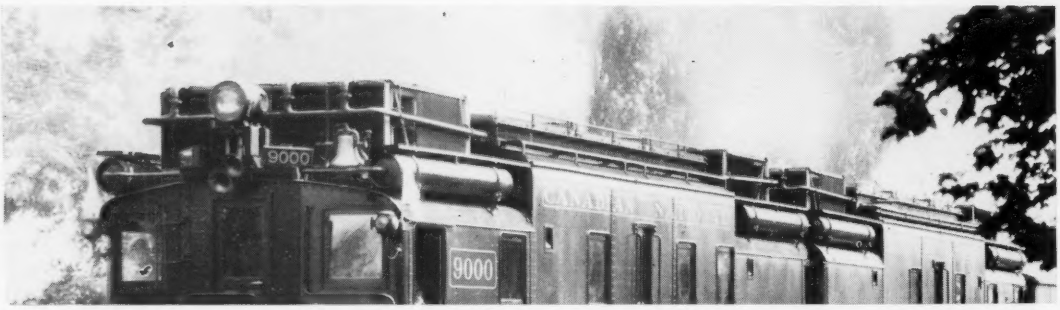


Fig. 11

Design is always changing: 2 **E. T. Burch**



The railways . . . .



Top—An old timer, complete with oversize stack. Bottom—The CNR 9000 makes history on initial run.

. . . . Canada's international design contributions

Conversion of the railroads from steam to diesel power is proceeding more rapidly than most people realize. While actual figures cannot be obtained, one railroad official stated that "if you want any pictures of steam locomotives in action, you'd better get them before the end of 1960—less than 300 are in existence in Canada today". In the United States the change-over is likewise almost completed.

In the search for a new source of motive power after the end of World War I, electrification was the trend. It remained for two CNR engineers, with the enthusiastic backing of Sir Henry Thornton, to develop the diesel-electric locomotive. Essentially the same principle is used in today's diesels.

The new idea was first used in 1929 in the CNR's No. 9000, the world's first successful application of the diesel engine as railroad motive power. Its story is told in this article—the second in DE's series of design pioneered by Canadians.

See January, p. 46, for the first article in this series.

In 1829, George Stephenson's "Rocket" startled the English countryside by thundering along two miles of track carrying its load of 30 nervous passengers at the unheard of speed of 29 miles per hour, and the age of steam was born.

Almost exactly one hundred years later, on Aug. 26, 1929, a newly designed Canadian locomotive, the CNR's spectacular No. 9000, purred along its inaugural run of 334 miles between Montreal and Toronto, and started the trend to dieselization. No. 9000, designed and built by Canadian engineers, was the first successful use of the diesel engine as railroad driving power, and its introduction spelled the end of steam for railroads all over the world.

Although No. 9000 attracted as much attention as the "Rocket" when it was introduced, the initial excitement died down and remained dormant for almost a decade. But its design was directly responsible for the current revolution in railroad motive power. Today, there are fewer than 300 steam locomotives still in active service on Canadian railroads, and about the same number in the U. S. A.

No. 9000 was the brain-child of two Canadians—C. E. Brooks, CNR's Chief of Motive Power, and S. J. Hungerford, vice-president in charge of Operations and Construction. To a lesser extent, two others helped bring No. 9000 into the world—R. J. Needham, Me-

No. 9000's giant engines weighed over 50,000 lb. each. Here one is lowered into place at the Canadian Locomotive Works, Kingston.

chanical and Electrical Engineer for CNR's Central Region, and E. W. Oliver, manager of Canadian National Electrical Railways. These were the men who designed and built No. 9000, but perhaps the most significant Canadian of all was Sir Henry Thornton, who gave the project his enthusiastic support.

Diesel design history

It was not for lack of trying that the world's railroads had not chan·ed their traditional use of steam since the days of the "Rocket". Many unsuccessful attempts had been made to find a more efficient fuel, but the triumvirate of mandatory requirements for motive power were hard to meet—economy, speed and load capacity. The trend in English and American railroads was toward electrification, using the third rail or the overhead trolley. Canadian railroad engineers were dubious; the thought of adapting the thousands of miles of track to either system was overwhelming.

By 1920, the Swedish state-owned railways had designed and built a diesel-powered locomotive. CNR's Brooks made a trip to inspect it—but discovered that its large bulk made it impractical for use in Canada, and that its brake hp per ton of weight made it inefficient for Canadian railroads. He also inspected two Russian switching engines powered by diesels generating electricity in direct drive from generator to electric traction motors, but these proved to be cumbersome, inefficient and unreliable.

Then, in 1923, Brooks saw a new, light-weight diesel engine which had been developed for the British Air Ministry for use in lighter-than-air dirigibles. It seemed to offer possibilities for adaptation to railroad use, as it developed more hp per ton of weight than anything available at that date. He bought the engine and had it shipped to Canada.

From this slender beginning was born the idea that changed railroad history. Around the new engine Brooks and Hungerford designed an oil-electric car, the first of its type ever conceived. On Nov. 1, 1925, the new car made its debut, making the trip from Montreal to Vancouver, a distance of 2,937 miles, in exactly 67 running hours, without stopping the engine.

This epoch-making trip broke three world's railroading records, and designers the world over were eager to learn the details. Brooks revealed that the nucleus of a new power principle had been found—the diesel engine drove electric generators, power was stored in a bank of batteries and then used to drive electric traction motors—providing a smooth, constant driving power. The inaugural run established the diesel as an efficient source of railroad power, and from that moment on, steam was doomed. No more coal to be shoveled—no more taking on huge quantities of water at every divisional point—and the new fuel relatively cheap and plentiful. It remained to develop the car into a true locomotive. Engineering design for a locomotive using the diesel was begun at once—to be known as CNR No. 9000.

The mighty No. 9000

No. 9000 was built at the Kingston plant of the Canadian Locomotive Works, from plans prepared by the Baldwin Locomotive Works, under CNR specifications, and under the supervision of the Westinghouse Electric & Manufacturing Company. She consisted of two oil-electric power units, the largest ever built, each weighing 55,000 lb, and each fitted into a separate section of the locomotive, which at that time was a new and daring design concept. The public was staggered to learn that the generating capacity of the new locomotive was sufficient to supply a city of 14,000 residents with light and power for all needs.

Each of the two units weighed 310 tons when fully equipped, of which 230 tons were carried on the 16 driving wheels. The balance of the weight was distributed over the 12 truck wheels. She had an over-all lenght of 94.1 ft.

No. 9000 came through the test

On time to the minute, No. 9000 purred smoothly out of Bonaventure station in Montreal at 10.30 on Sept. 26, 1929, without so much as a discreet cough, her two huge diesels generating electric power for her traction motors. Sitting by himself in a rear coach, watch in hand, was her designer, C. E. Brooks, jotting down performance data in a little black book. He noted with satisfaction that every stop was made on the second, and that every start was made so smoothly the observers were never sure of the exact moment the train started. On arrival at Toronto's Union Station, his only comment was: "We are all very satisfied; it has been a remarkable run, and we have realized the potential of the oil-electric engine."

continued ▶

Next day, as guest of honor at the CNE's Railroad Day luncheon, Mr. Brooks elaborated on what had gone into No. 9000's design and development. He pointed out that while some power was lost in transferring the engine's energy into electricity and back to driving power, the 8,000 hp developed by this revolutionary new locomotive was used all the time, which was not true of the steam locomotive. He outlined the results of the design team's findings, pointing out some of the false leads that had been followed before the design was "frozen". "Comparing the amount of work No. 9000 gets out of a given amount of fuel with a conventional steam engine gives us a ratio of seven to one," he stated.

That statement, carried around the world, opened the eyes of railroad engineers, and spelled the end of the era of steam. Studying his report in detail, they saw proof of what No. 9000 meant. Among the eye-opening facts were proof of:

Superiority of oil over coal in economy of operation; unexcelled smoothness in starting and stopping; shorter operating schedules, from the fact that No. 9000 accomplished the transition from peak speed to stop and back to peak speed in less than half the time and distance needed by the steam locomotive; capability of sustained high speeds, coupled with a draw-bar pull equal to the requirements of modern water from 20,000 gallons for the Montreal-Toronto railrouding: and that No. 9000 cut the need for water to a negligible amount for cooling the engines.

Acclaimed by the world

The world lauded the Canadian locomotive. "It is a matter for considerable satisfaction that the achievement was the work of Canadians," stated the Toronto Telegram. Under the heading "Triumph for New Locomotive", the London Daily Telegraph carried a full account on No. 9000's demonstration run, praising its speed, economy of operation, and its ingenuity of engineering design.

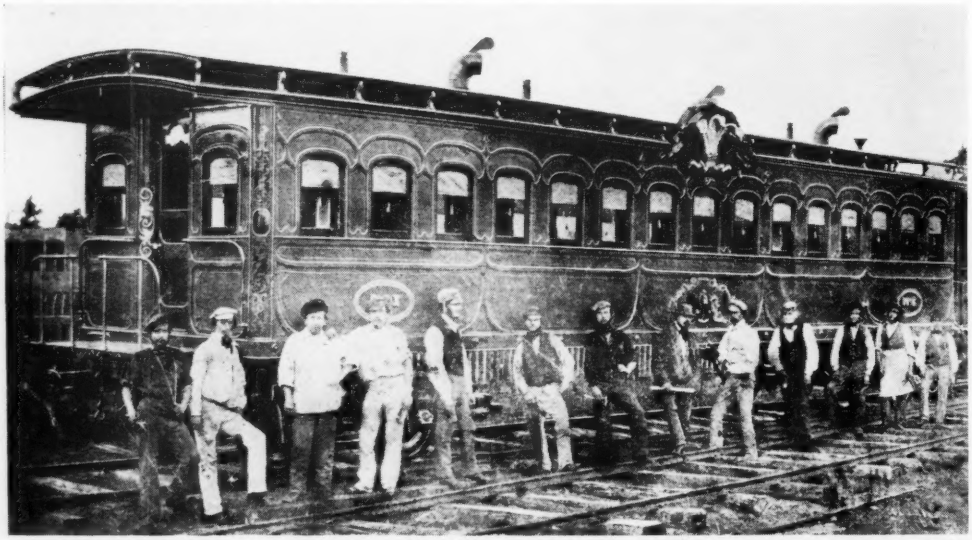
The Brooklyn Eagle reported: "In this epochal day of the trans-Atlantic airplane and the globe-trotting dirigible . . . the railroad locomotive finds it hard to crash the popular fancy. That it can be done, was demonstrated when the new oil-electric locomotive of the Canadian National Railways made its inaugural run . . . presaged a new era in railroad transportation. An engine that can and does pull a standard sized train under restrained power at from 60 to 70 miles per hour—and leaves no trail of cinders and smoke in its wake!"

The Wichita Eagle mourned the puff and sizzle of steam, but noted that "the old-timer's coal bill ran to $80.00 for the trip. The stranger's oil bill was only $25.00!" "For years the railroads have been looking forward to the time when they could use such an engine," stated the Chicago News-Journal.

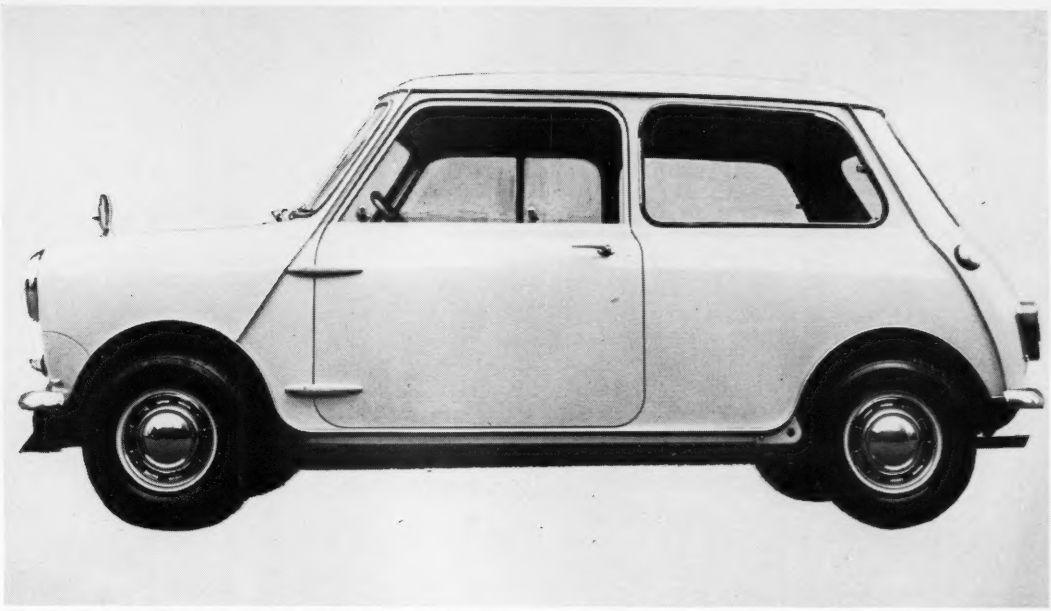
In its issue of October, 1929, describing the run, the CNR staff magazine stated: "No. 9000 . . . fulfilled the three cardinal features for which engineers have sought—economy of operation, speed, and hauling power. But the answer to that uppermost question, What of the future of transportation?—lies yet in the lap of time."

In private conversation, many Canadian railroad men will state that if it had not been for the depression, followed by the war, the CNR would have been fully dieselized by 1940. Thus the CNR's No. 9000, the original diesel-electric locomotive (with essentially the same design principle in use today), came from the drawing boards of Canadian design engineers to lead the railroads away from steam to the era of diesel-electric driving power. ★

One hundred years ago . . .



. . . this is how they looked. A special car built in Brantford Car Works in 1860 for the use of the Prince of Wales during his visit to Canada.



Simple lines predominate in baby Austin. Profile illustrates minimum overhang, generous glass area, wide door.

Design philosophy of new Austin 850

Full of engineering surprises, this small car is a bold, British package

Eric Haworth

During all the trumpet blowing for the 1960 small cars, we heard the almost self-conscious beep of a new contender from the U. K. It was the current version of an old favorite—the Austin 850.

Even when compared with Austin's pint-sized A-40, the unit boasts many interesting design elements. These combine to make a remarkable automobile selling at a fraction more than $1 per lb.

The 10-ft.-long, 1,275-lb. car is capable of exceeding 70 mph, and gives 60 mpg at a steady 30 mph. It will also reach 50 mph from rest in 18 seconds and has variable rate all independent rubber suspension.

This significant contribution to automobile engineering techniques was originated by a small, but big-thinking design and development group over the last two years.

The size of the car fixes, for practical purposes, the weight of the structure and this influences the cost. This weight factor also influences fuel and tire consumption in normal driving. So by this token the major need of a small car is that it be just that-small and light. But if four persons are to be carried in reasonable comfort, there is a minimum size, even if no allowance is made for engine and luggage.

These dimensions can be set out thus:

1. pedal travel	4 in.
2. front leg room	18 in.
3. front seat	18 in.
4. front seat cushion ...	4 in.
5. rear leg room	6 in.
6. rear seat	17 in.
Minimum platform length =	67 in.

But there must be a projection beyond the wheel arch at each end, and because of stability the wheel track should be not less than 48 in. So the smallest possible four seater vehicle will be 110 in. long, 50 in. wide and 51 in. high.

Yet what about power unit and luggage space? On the Austin 850 the necessity for extra length has been bypassed by a new design concept. It is achieved by an engine and front drive transmission which doesn't encroach on the passenger carrying area.

Mr. E. Haworth is former assistant editor of Design Engineering.

continued ▶

Bold, audacious—the Issigonis Transverse Triplane installation, as it is called, puts the transmission gears directly beneath the crankshaft, in the sump, and mounts this package transversely at the front of the car.

Except for a slight protrusion, for the exhaust pipe, the floor is flat. Coupled with the absence of a rear axle, this makes possible a low roof line, and a small frontal area with adequate headroom.

As the engine doesn't demand any longitudinal space, the car accommodates four passengers and substantial luggage in its 120-in. The engine/transmission layout and the general configuration of the vehicle also play an important part in securing aero-dynamic stability.

With increase in road speed, the centre of wind pressure moves steadily forward. If it advances sufficiently ahead of the centre of gravity, a side wind acts through a long lever-like action to prize the car off the straight course.

On the Austin 850 the centre of gravity is far forward. So the relatively long, parallel sides of the body behind the centre of gravity act in themselves as a strong, stabilizing influence.

Suspension problems peculiar to small cars

Metal springs, be they leaf, coil, or torsion bar, are deflected in exact proportion to load. For example: 100 lb will compress the spring 1 in.; 200 lb compresses 2 in.—and so on. But as the laden weight of a small car may vary, many arrangements have been proposed to give the suspension system a more variable rate, 100 lb deflecting through 1 in., but (say) 70 lb more being required for the next half an inch and 100 lb for the next half an inch. In this case a load of 270 lb in place of 200 lb would be carried for a 2 in. deflection.

These arrangements are complex and unsuited to large scale production and have affected the small car owner in several ways. Not the least important is how the solo driver of small cars has had to endure a rough ride—a ride dictated by the mathematics of a fully laden situation.

This problem has received a lot of attention in the Austin 850. For the first time on a large production vehicle, independent suspension by rubber to all four wheels is applied so as to secure a marked variation in suspension rate. This is done with a most economic use of material but without complications of construction.

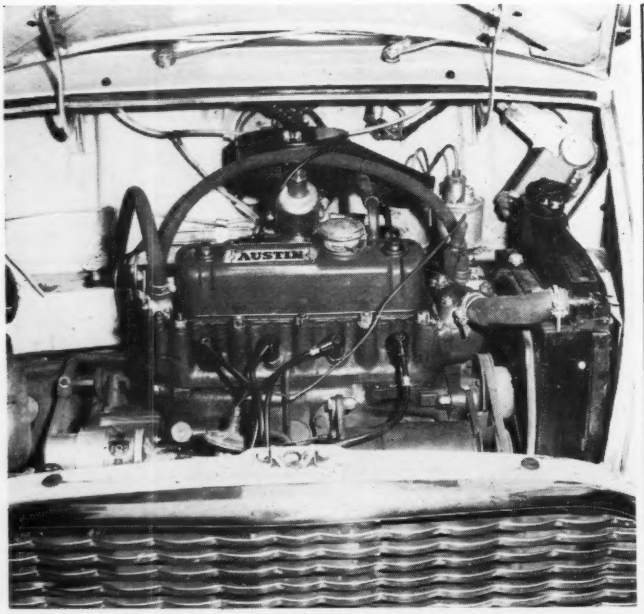
The four rubber suspension units on the car have a weight of 6 lb only, yet they support the fully laden weight of the car—1,800 lb.

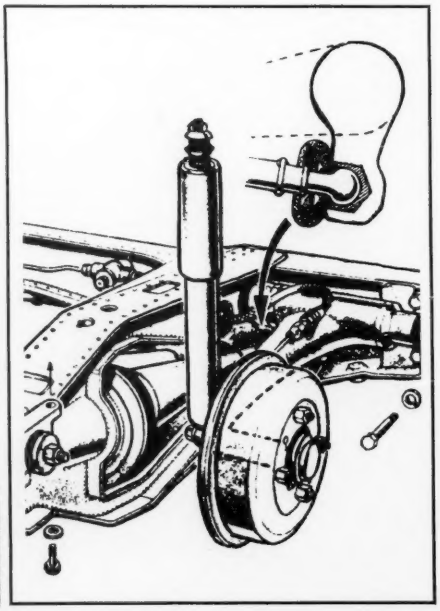
The rubber units themselves are comprised of an inner and outer metal cone with a high-resilience natural rubber compound bonded between them. On deflection, this is subjected to combined compression and shear. The special shape of the rubber cross-section (developed by extensive experiment and photo-elastic study), has resulted in an extremely compact unit. The design, with its uniform strain distribution throughout the rubber, ensures an expectation of life not less than that of the car.

At the rear end of the car, unsprung weight is reduced to a minimum by complete elimination of an axle beam. The wheels are located on trailing arms in such a manner as to have a vertical rise and fall. Wheel movements are thus reduced to one fifth at the rubber springs.

Braking

When over 60% of the weight of the car is carried by the front wheels, it would seem desirable in the driver-only position to divide the distribution of braking





Engine is mounted transversely (radiator core extreme right) and it's easy to get at. Line drawing shows how the suspension units are carried on detachable sub-frame. Rubber buffers support car's fully loaded weight.

effort in the ratio of about 80% on front wheels and 20% on the back. But in normal motoring such a division would lead to an unnecessary loading of the front wheel brake system and an unnecessary high rate of wear on the front friction linings.

To avoid this, the Lockheed brakes are biased by a limiting valve. With pedal pressures below 40 lb (the equivalent to a stopping distance of 75 ft at 30 mph), the main line hydraulic oil pressure is distributed equally to front and rear systems. Above this pressure, a plunger is forced on a seat by a spring, and further increases in the main line hydraulic fluid pressure are transferred solely to the front wheels.

Body and sub-frame

With a stressed hull as the primary structure, the small dimensions of the car contribute to the low weight of 310 lb. The floor is stiffened, as a beam and in torsion, by the front and rear sub-frames which also serve as mounting points for the suspension links and, at the front, for the engine/transmission/cooling.

All these parts are built on sub-frames before they are placed on the assembly line. In this way an accurate alignment of each pair of wheels can be predetermined and neither assembly nor inspection is hampered by the proximity of metal panels.

On the assembly line, the hull is dropped on the sub-frames which are quickly and accurately bolted to it and can, in case of accident, be removed easily and replaced by new components.

Maintenance

Maintain-it-yourself motorists have been well catered for in the Austin 850. Engine, gearbox, and final drive all use a common lubricant restored when necessary through a single intake orifice. Forward-facing distributor and spark plugs are easy to get at and adjusting carburetor and tappets is fairly simple, as is lifting the cylinder head.

The rubber springs are naturally quiet and fatigue-free and the hydraulic shock absorbers self-damping and lightly loaded. They should be capable of running long distances without attention or renewal. Relatively little routine chassis lubrication is required and there are no difficult oiling points.

Driving the car

After several weeks of negotiating, DE was provided with one of the two Austin 850 models in Canada, for testing. The mileage on the "clock" was 1,845 and the car had been driven pretty hard, we were told.

Our first reaction on entering the car was to duck our head, but this was unnecessary. Headroom is most adequate—even when wearing a hat. The next impression, once seated in the bucket-type seat, was of the excellent all-round visibility. The deep windshield and sliding windows are big contributors to this safety factor.

Every person who rode in or drove the car during the test period, was surprised at the wealth of room inside the car. In fact it would be true to say that every inch of space has been used.

The front seats tip forward to give access to the rear foam rubber seat. We noticed in doing this that there's plenty of space under the back seat for stowing parcels or hand luggage. As a bonus, built into each of the front doors is a deep tray for maps, flashlight and other driving paraphernalia. Then there's a wide parcel shelf under the dash.

SPECIFICATIONS

ENGINE DIMENSIONS

4-in-line cylinders

Bore: 2.478 in.

Stroke: 2.687 in.

Compression ratio: 8.3 : 1

Max. bhp (gross): 37 @ 5,500 rpm

ENGINE CONSTRUCTION

Main block: Cast iron, no cylinder liners

Crankshaft: forged steel, no damper

Main bearings: three, shell type

Pistons and rings: split skirt, three compression and oil rings

Valves: tappets, pushrods and rockers, O.H. valves vertical in cylinder head

TRANSMISSION

Clutch: single dry plate 7⅛ in. hydraulic operation

Gearbox: four speeds, synchromesh on upper three ratios

Final drive: helical spur gears. Ratio 3.76 to 1.

Starting the car is not as simple as it could be. We wondered why it was necessary to make the driver grope on the floor near the front passenger seat for the starter button, after turning on the dash ignition.

The four-speed-pattern gearbox is activated by a floor-mounted gear-shift. Slip into first and you're heading for a barrelful of surprises. The car whips away from rest with power unsuspected for an 850 c.c. engine, and we quickly discovered that working through the gears is part of the pleasure of driving this car.

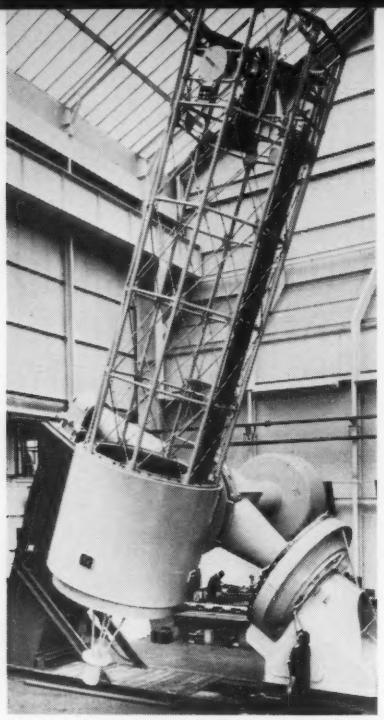
Once under way, two facts come to light quickly. First, the positive feel of the rack and pinion steering. Second, the complete control the frontwheel drive gives the car. This is very noticeable when cornering. In fact the way the front wheels hug the curb, it might well be magnetized.

The nimbleness of the Austin 850 in heavy traffic is one of its most desirable features. Once clear of congestion, the lightest pressure on the accelerator sends the car leaping past the legal speed limit and a $30 fine could be acquired in a brace of city blocks.

We had no difficulty in finding washboard streets and pot-holes in the downtown area of Toronto. But the independent four-wheel suspension transmits few shocks to driver or passengers, we discovered.

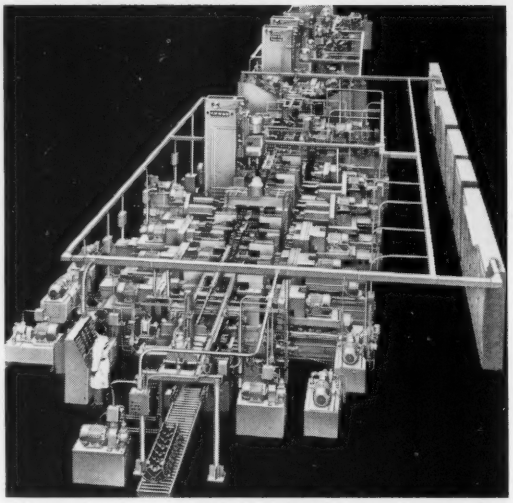
The car does have some faults. Reverse gear, for example, was difficult to engage, and to do so intrudes on front passenger comfort. (From neutral position, the gearshift is pushed to extreme right, then hard down.) Closing the doors from inside could be improved by providing a simple handle. A rear view mirror large enough to cope with city driving would be desirable. We also feel that the North American driver won't like the "togetherness" of the foot pedals—in themselves Lilliputian.

Altogether the Austin 850 comes as close to anything we have seen to the elusive "ideal" second car. Its lively performance, true economy and unusual body space should make it a winner with Canadians. ★



Giant telescope will be largest in Asia — made in Britain for Japanese observatory.

Designews in Pictures

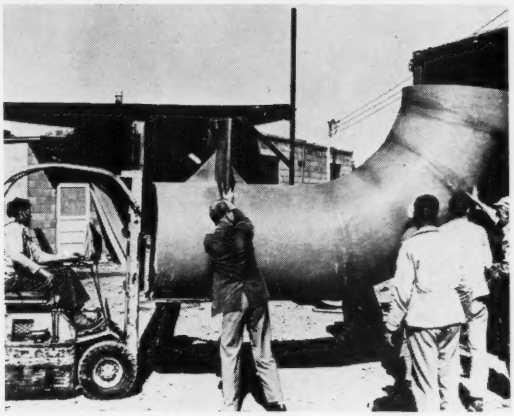


V-6 and V-12 truck engine blocks are automatically machined on this versatile machine—it bores, reams, taps, chamfers and spotfaces.

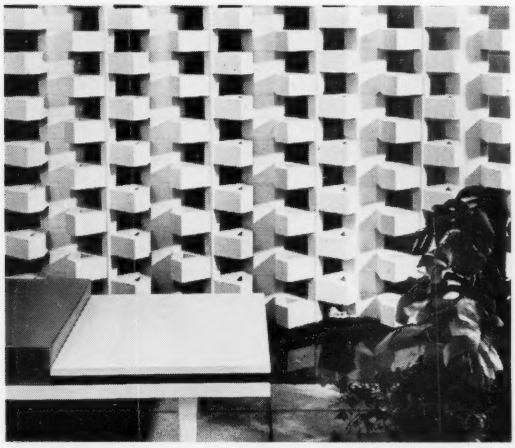
Smallest (.260) and biggest (5.218) powdered cores for electronic equipment used in missiles.

The first to be installed in a department store — a moving sidewalk for milady.

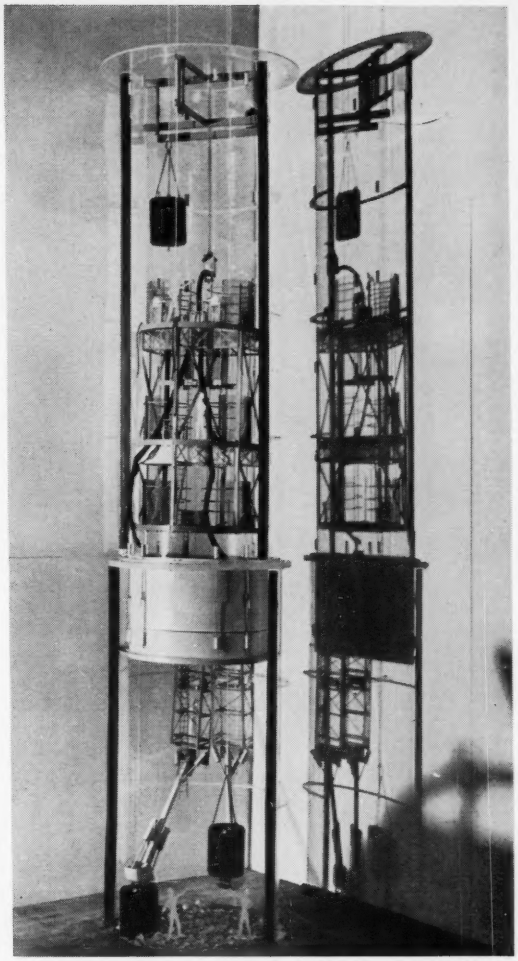
Another Council of Industrial Design winner — made of polyethylene with molded-in handle and splash guard.



Huge elbow, 48 inches in diameter, is a component of a new ventilating system.



Lacy luxury created wth basic concrete building blocks.



Model of triple-deck time saver to be used in 300-foot potash mine shaft in Saskatchewan by International Minerals & Chemical Corporation.

Instrument bearings like this one cost as much as $130,000 a pound — many times their weight in gold.

Electronic rivet-head inspection device provides increased accuracy and cuts inspection time.

Air curtain safely seals open doors

Phantom door designed for heavy traffic — smooth flow assured

If something can be said to be conspicuous by its absence, then it can certainly be applied to the new style doors without doors. Although installations have been made on at least four of the continents, they still evoke curiosity every time they are encountered.

The phantom door is a curtain of air which is being constantly recirculated in the passageway usually occupied by a door. The air curtain hermetically seals the inside from the outside, thereby forming a most effective entrance for a store or other premises.

The air curtain is so effective that even dust and insects are kept out. It is claimed that even stray cats and dogs are deterred from entering.

The principle of the DOR-less-DOR and its major parts are shown in figure 2.

History of air curtain door

Air curtain doors were first tried in 1904, according to available information. However it is not recorded that the attempt was successful.

Various other designs were developed throughout the years and in 1951, a Brussels department store had a curtain door installed. There are no records of the inventor.

In 1952, Sulzer Brothers, a manufacturing firm in Switzerland, came out with the DOR-less-DOR design, and today this sets the pattern for most of the known installations.

World's biggest

The world's widest entrance has just been completed at Idlewild Airport. The design of this 90-foot entrance to Pan American's Terminal was based on wind tunnel tests made at the Federal Institute of Technology in Zurich, Switzerland.

The first air curtain door in Canada dates back to 1956 and still creates comment from those who enter Montreal Pharmacie for the first time.

Doorless entrances are found in banks, stores, office buildings and night clubs in the U.S.A. However they still arouse interest in that country, where even the toddler is bored with stories of space flight.

Design factors

Air curtain entrances are at full advantage whereever heavy traffic is encountered. Be it pedestrian or vehicular, traffic will flow smoothly through.

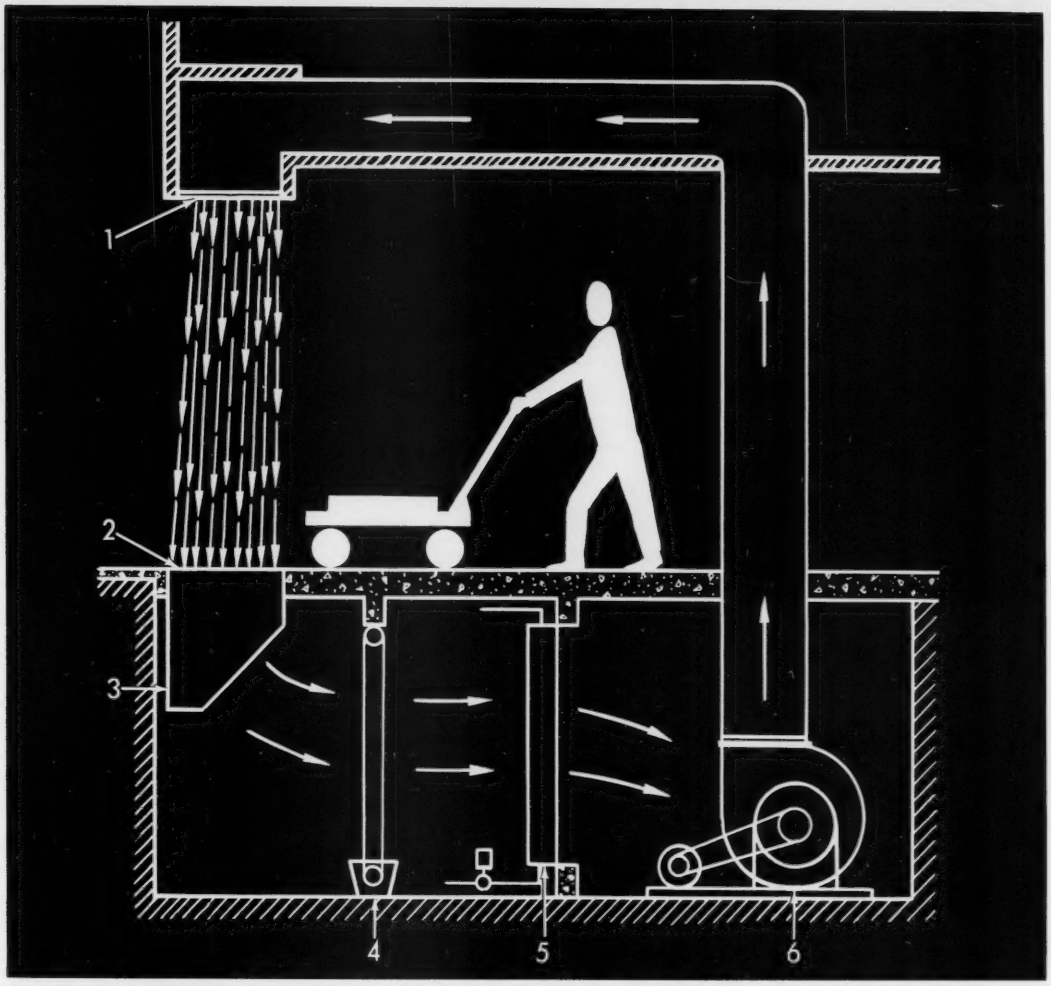


Fig. 2. Operating principle and main components of the air door. Parts shown are: 1. outlet grille. 2. inlet grille. 3. sump. 4. filters. 5. heater-cooler. 6. circulating fan.

Raw materials can be moved via belts or roller conveyors from building to building without creating frigid polar blasts, thereby solving another problem which has plagued the design engineer in industry.

In cold storage installations, the air curtain can replace bulky refrigerator doors, prevent fogging and loss of refrigerated air. Warehouses, truck terminals, canning and bottling plants, and meat packers are some typical functions which can benefit by its use.

The design follows the basic laws and principles of aerodynamics. The most important calculation is to determine the quantity of air required to maintain the proper pressure differential between the outside and the inside.

The grille (see part 1, fig. 2) is the main component. Perfect and equalized distribution of air in this grille is essential.

The fans can be driven by conventional methods. Changes in weather conditions, especially pressure differences resulting from outside winds, can be met by speed regulation, which results in changing air volume and velocity.

Speed and direction of the air screen can be adjusted automatically or manually, depending on choice of the designer. Air temperature is generally controlled automatically. Velocity is relatively low, and is gentle enough not to disturb milady's hair or hat. The floor grating, too, is designed to take care of the modern spiked heel (see illustration on opposite page).

What is the cost?

The installed cost obviously depends largely on the customer's requirements, whether the building is old or new, and the number of controls desired. However we can give you some guides.

The cost has been found to range from $750 per linear foot for industrial to $2,000 for commercial applications. The greatest number of installations have been from $750 to $1,400 per linear foot.

Operational costs, again, depend mainly upon location. For a 10 ft wide entrance in New York, the cost of operation averages 10c per hour in the summer to a high of 50c per hour in the winter.

The potentialities of this new type door are a real challenge to the design engineer. The surface has hardly been scratched. ★

Here's your chance to win
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YOU CAN WIN

1ST - $100

2ND - $50 3RD - $25

PLUS

5 ADDITIONAL PRIZES
OF FIVE DOLLARS EACH

A total of eight winners

Here's all you have to do—write 300 words or less on any ONE of the following subjects dealing with fluid power (hydraulics or pneumatics):

A What I want to know about fluid power. **B** Fluid power problems in my industry. **C** Future trends in the fluid power industry. **D** What's wrong with the Canadian fluid power industry (with special reference to design of components, distribution, merchandising, or services provided).

YOU MAY SUBMIT ENTRIES ON ALL FOUR SUBJECTS IF YOU WISH

Literary style doesn't count —entries will be judged on the basis of ideas presented — and ability to transmit these ideas in such a way that others can profit by them. Judging will be done by a special panel from the

FLUID POWER INDUSTRY

CONTEST IS OPEN TO ANY RESIDENT OF CANADA. *Entries must be postmarked not later than April 30, 1960, and should be addressed to:* THE EDITOR, DESIGN ENGINEERING, MACLEAN-HUNTER PUBLISHING CO., 481 UNIVERSITY AVE., TORONTO 2, ONT. *All entries become the property of Design Engineering, cannot be returned.*

Winning entries will be published in the July issue (Hydraulics and Pneumatics) of **Design Engineering**

Design Engineering DATA SHEET

Definition by Formula

ABBREVIATIONS:

BTU	British Thermal Unit—1 BTU = Heat required to raise temperature of one pound of water 1° F.
C°	Degrees Centigrade
Cal	Calorie—1 CAL = Heat required to raise temperature of one gram of water 1° C.
C C	Cubic Centimeter
Cu Ft	Cubic Foot
Cu In.	Cubic Inch
F°	Degrees Fahrenheit
FPS	Feet per second
Ft	Feet (foot)
Gal	U.S. Gallon
GPM	Gallons per minute
HP	Horsepower = Work at rate of 33,000 Ft Lb/Min
In.	Inch(es)
Lb	Pound(s)
Min	Minute(s) of time
PSI	Pounds per square inch
Rev	Revolution (of shaft or pump)
Sec	Second(s) of time
Sp Gr	Specific Gravity—Ratio of the weight of a body to the weight of an equal volume of water at 4° C or other specified temperature.
Sp Ht	Specific Heat—Ratio of heat required to raise a unit weight of a substance 1° F to the amount of heat required to raise an equal weight of water 1° F at a certain temperature (hyraulic oil is approx. 0.45).
Sp Wt	Specific weight or weight density = Lb/Cu Ft; Lb/Cu In. or grams/C C.
Sq In.	Square inch(es)

SYMBOLS:

A	Area
a	Linear acceleration (FPS^2), rate of change of velocity
α	Angular acceleration (Radians per Sec^2)
C	Compressibility of oil (Cu In.)
D	Density, mass per unit volume
E	Energy
F	Force, (Lb) an influence which produces or tends to produce, motion or change of motion.
f	Coefficient of friction
g	Acceleration of gravity (FPS^2) = 32.16 FPS^2 at sea level
H_e	Elevation head
Hg	Mercury
H_p	Pressure head (static)
H_v	Velocity head
L	Gallons per minute (GPM)
M	Mass = Slug = $\frac{W}{32.16}$; or, a mass which, with an unbalanced force of 1 Lb acting upon it, would have an acceleration of 1 FPS^2.
M_f	Mechanical friction
N	Revolutions per minute (RPM)
ΔP	Pressure differential (DROP)
P	Pounds per square inch (PSI)
r	Arm (torque), radius in inches
T	Torque (inch-pounds)
U	Velocity (FPS) rate of change of distance (length)
V	Volume (Cu In.)
W	Weight (Lb) force which gravitation exerts on a material body.

◀ continued

ACCELERATION

$$a = \frac{F}{M} = \frac{Fg}{W}$$

From $F = Ma$ and $M = \frac{W}{g}$

$$\alpha = \text{Radians/Sec}^2 = \frac{\text{Degrees/Sec}^2}{57.3}$$

COMPRESSIBILITY OF OIL

$$C = \frac{PV}{250{,}000}$$

DENSITY

$$D = \frac{1728M}{V} = \frac{\text{Sp Wt}}{g} = \frac{\text{Lb/Cu Ft}}{32.16} \text{ (at sea level)}$$

or $\frac{\text{GRAMS}}{cc}$ (at sea level)

ENERGY

$E = H_e + H_v + H_p$ = Total energy contained in fluid

FLOW

Through an orifice—see PRESSURE DROP

FORCE

$F = AP$

FRICTION-MECHANICAL

$M_f = W \times f$ Note: Static (or breakaway) friction coefficient is greater than kinetic (or moving) friction coefficient

---

GRAVITY

$g = 32.16$ Ft/Sec^2 (at sea level)

GRAVITY-SPECIFIC

Ratio of weight of a substance to weight of equal volume of water

For hydraulic oil = 0.9 (approx.)

HEAD-ELEVATION

Height of liquid (or fluid) in feet above reference plane. To express in Ft of water:

H_e = Vertical height of liquid above reference plane $\times$ Sp Gr

---

HEAD-VELOCITY

$$H_v = \frac{U^2}{2}$$

HEAD-PRESSURE (static)

$$H_p = \frac{U^2}{2g} = P \times 2.309$$

HEAT

Btu/Min = L $\times$ Sp Ht $\times$ Lb/Gal $\times$ Temperature change (F°)

Data sheet *continued*

HORSEPOWER

$$HP = \frac{FU}{550} = \frac{LP}{1714} = \frac{TN}{63{,}025}$$

MASS

$$M = \frac{W}{g} \text{ or, at sea level, } = \frac{W}{32.16}, \text{ or } = \frac{W \text{ (grams)}}{980}$$

Note: Mass is constant regardless of altitude.

ORIFICE AREA

See pressure drop.

PRESSURE

$$P = \frac{F}{A} \text{ (consistent units)}$$

PRESSURE-ATMOSPHERIC

Normal = 14.7 Psi = 29.92 In. Hg = 33.9 Ft water

PRESSURE DROP

For oil hydraulic systems, the following will approximate pressure drop through "short orifice" (¼ to ½-inch long-length not over 3 times diameter)

$$\Delta P = \frac{0.001056L^2}{A^2}$$

For specified pressure drop:

$$A \text{ (required)} = \frac{0.0325L}{\sqrt{\Delta P}}$$

RADIAN

Arc (of circle) = Length of radius (see velocity, angular)

$$\text{In degrees} = \frac{360}{2\pi} = \frac{180}{\pi} = 57.3°$$

SPRING RATE

$$\frac{F}{\text{Distance compressed (or stretched) where distance is from the free length.}}$$

TORQUE

$$T = F \times r = \frac{HP \times 63.025}{N} = \frac{\text{Cu. In./Rev} \times P}{2\pi}$$

VELOCITY, Angular

$$\text{Radians/Sec} = \frac{\text{Degrees/Sec}}{57.3}$$

VELOCITY, Flow

$$U = 0.321 \frac{L}{A}$$

VOLUMETRIC EFFICIENCY

$$\frac{\text{Actual Displacement}}{\text{Theoretical Displacement}}$$

Piston Type Pumps (displacement known)

$$E = \frac{V}{D}$$

Where:

E = Volumetric Efficiency
V = Volume Pumped in a given time
D = Theoretical Displacement in a given time, i.e. the space swept out by the pistons in a given time

Gear, Vane or Piston Type Pumps (displacement not known) known)

$$E = \frac{VP \times NO}{VO \times NP} \text{ (Approx.)}$$

Where:

E = Volumetric Efficiency
VP = Volume pumped in a given time at a given pressure
VO = Volume pumped in a given time at approx. zero pressure
NP = Rpm at given pressure
NO = Rpm at approx. zero

Hydraulic Motors

$$E = \frac{NP}{NO} \text{ (Approx.)}$$

Where:

NP = Rpm of piston motor for a given pressure
NO = Rpm of piston motor for approx. zero pressure and for the same volume of oil as supplied to the piston motor under the given pressure

WEIGHT

Sp Wt (Weight Density) = Lb/Cu Ft = Lb/Cu In. or = Grams/CC
Water = 8.34 Lb/Gal @ 39.2 F°
= 62.4 Lb/Cu Ft @ 39.2 F°
Hydraulic Oil = 7.5 Lb/Gal (Approx.)
= 56.0 Lb/Cu Ft (Approx.)

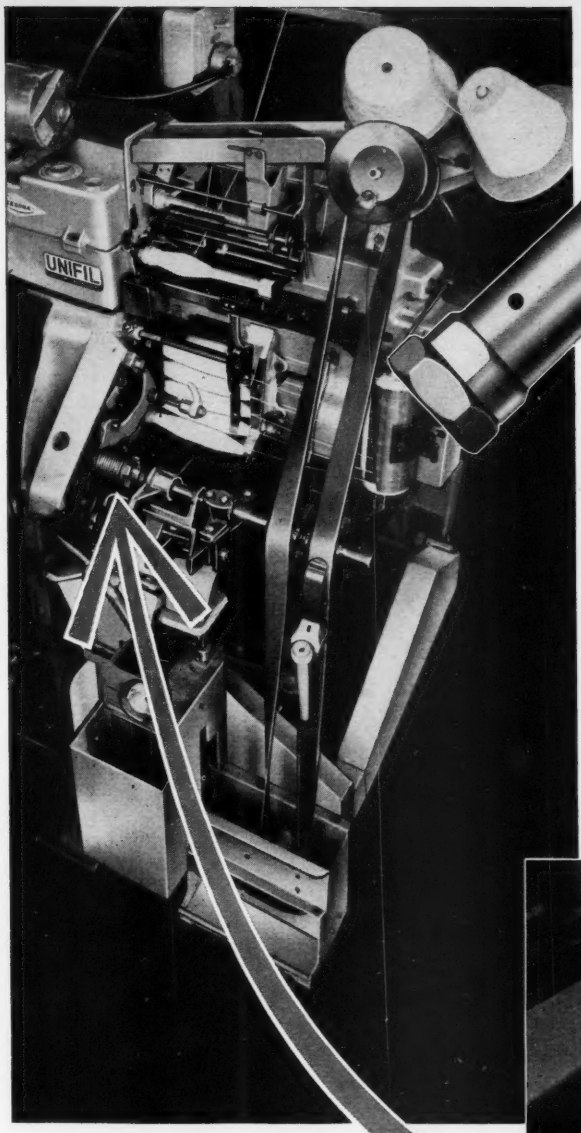
Coming next month . . .

exciting news for design engineers

The May issue will be a feature preview of the Design Show which will be held in New York city from May 23 to 26 . . . Canada will be represented as never before . . . over 20,000 engineers saw last year's show . . . should you be there this year?

Read what the experts say in next month's

Design Engineering



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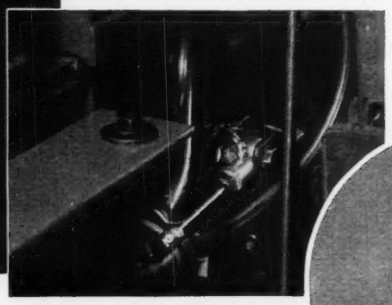

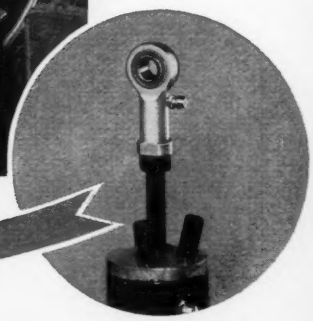

It is used here as a component of the air pump assembly on the Unifil® Loom Winder made by Leesona Corporation of Providence. This machine is united with the loom to wind the quills, transfer them to the shuttle, strip and return empties to the winder for uninterrupted weaving production. The Unibal Rod End is threaded onto the end of the air pump piston rod, and provides the necessary freedom for an up and down action. Unibal also reduces the skill necessary for a perfect lateral alignment.

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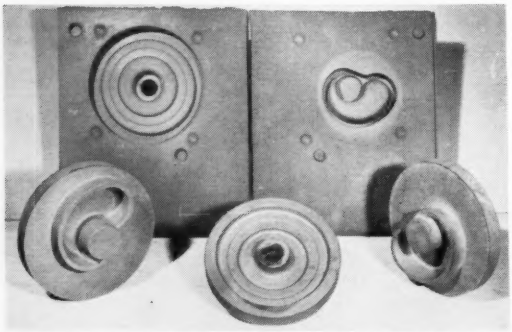
1. Shell bonding machine forms complete shell molds.

2. Dry silica sand and synthetic resin mixture is inverted over a pre-heated metal pattern in a dump box.



3. Shell molds measure approximately ¼ in. thick compared to the four or more inches for conventional molds.

Cost reduction is easy if you use shell molding

Machining and other finishing costs can often be reduced or eliminated

Would you like to reduce costs on your small molding jobs? Do machining charges add to your problems when designing parts to be cast?

Then you should give serious consideration to the use of shell molding and coremaking. Canada Iron Foundries, Toronto, has recently introduced this new technique in the manufacture of their alloy iron castings — and the results indicate that the move has been more than justified.

The new molds are a quarter of an inch thick, are rigid, and weigh only about eight pounds. They are therefore easily handled and stored and can be laid out for pouring in a fraction of the time required for conventional snap-flask molds.

But, more important, with these new shell molds it has become possible to reduce machining allowances to a minimum — in fact, machining can be eliminated completely in certain instances. This means increased acceptance for metals that were formerly difficult or impossible to machine. Ni-Hard and Domite "CM" with hardnesses in the region of 600 B.H.N. are typical examples of metals that have been turned down for applications where they would have given good results if a means of securing the castings to the main structure could have been devised. Now with shell molding and the subsequent minimized machining, such metals will undoubtedly come into more common usage.

Shell molding begins with the mixing of a dry silica sand and a synthetic resin. This mixture is then placed in a container and inverted over a pre-heated metal pattern.

After the pattern is removed from the dump box it is covered by a layer of partially cured sand/resin mixture. The uncured material falls back into the dump box. The layer of partially cured material is then baked further by a radiant heat oven which forms part of the machine. When baking is completed it is ejected from the pattern.

The complete shell is then broken in half and the opposite halves joined together to form one complete shell mold.

With the use of shell cores it is now possible to have as-cast threaded holes in hard metals. Bolts or studs can be driven into these holes after final heat-treatment. Shell cores can be used in both conventional and shell molded castings. ★

Want to be a manager?

Rate your potential by these ten questions

Want to be the boss?

Tired of working under a supervisor and anxious to run your own show?

Think you have been neglected in the promotion lists in your department?

Wait! Before we utter an emphatic **yes,** let's compare our qualifications with management's requirements. Though there's good money and rich satisfaction in being a manager, having a tougher job than we can handle spells only worry and failure. On the other hand, if we do have what it takes, knowing that we have it will help give us the incentive to sustain a drive to the top.

All of us—from the junior draftsman to the senior designer—should be aspiring to show we have what it takes to be a manager. To see how we rate, let's take the following basic "management potential" test. There are ten simple questions. These form a yardstick by which we can measure ourselves.

We will award ourselves ten points for each "yes" answer (remembering that we must be 100% honest with ourselves), five points for each "half-yes," and zero for each "no." Then we will see how we compare with the standards set up by the experts, as outlined in the accompanying table.

Do you really know your job? Doing your present job well is the only way you can advance to a better one, for past performance is how potential leaders are judged. You'll do your job better if you know **why** you do it—just where you and your job fit into the total company picture. This will not only improve your morale but, by giving you a better grasp of the organization's setup, prepare you for the next step up.

Do you look for better methods? Do you try to dream up ideas that will attract customers, increase sales, save the company money? Do you understand and work at the important function of finding the most efficient way to get things done? Do you participate enthusiastically in the company's suggestion plan. *(We remember distinctly a case where the decision on which of two men to promote was based entirely on their activity in this program—Editor.)*

Do you like dealing with people? No quality is more important to an executive. The opinion others have of you is often a reflection of what you think about them; if you like them, they'll like you—and *work for you!* This doesn't mean that you must be friendly to the point where you fail to criticize poor efforts. It does mean, on the other hand, that your criticism should be aimed at helping your subordinate, never at merely boosting your own ego.

Check your score

95 to 100—You have it. If you keep up the good (hard) work, you have an excellent likelihood of reaching the top. You are an extraordinary person.

85 to 90—You are definitely management material, but you'll be wise to step up your efforts if you want to live up to your potential.

75 to 80—You **can** make it, but you have a lot of competition. Scrutinize the questions on which you lost points, then ask yourself how you can improve.

65 to 70—The odds are against your landing a job in top management **unless** you can lick those traits that have cost you so many points.

Below 65—Being a manager isn't everything. Your best bet is to seek success as a spouse and as a citizen. If you have the gumption, a management position **is** barely possible but you would probably be happier seeking a career in another direction.

continued ▶

Manager potential *continued*

Do you seek responsibility? If you look around for something to do when your immediate assignment is fulfilled, if you stay with a job when others would let down, if you're willing to show someone else how to do something, you're the "responsible" kind who's likely to go places.

Have you heard that the way to get ahead is to keep information to yourself to "get the jump" on others? Forget it! Everyone respects brains, and management knows that someone who offers suggestions to help fellow employees is a good man for a key job. Because supervision—a prime executive task and talent—consists largely of teaching others, helping them to do their work better.

Are you willing to learn? The potential executive knows that he must literally *learn to succeed*—by taking courses, talking to superiors or more experienced coworkers, keeping up with trade literature. But technical knowledge is not the whole answer. Many management training programs, for instance, emphasize the development of lifelong study habits that have little to do with booklore. Managers learn to look at what is going on about them; they learn what goes on at the competition; they learn to recognize the needs of their company's customers; they learn, learn, learn. By the same token, learning all you can about the people your firm serves will help you do a more effective job now—and boost your managerial potential.

Do you accept criticism graciously? Taking criticism personally is not only a sign of immaturity—it's a sure way to cheat yourself of good will and valuable pointers. If you honestly think your critic is wrong, speak up and make counter-suggestions. But be sure you speak from knowledge and not from hurt pride — especially if it's the boss whose opinion you're challenging.

Can you express yourself well? Unless you can phrase your thoughts clearly and concisely, you're not adequately equipped to tell others what to do. Numerous personnel studies have shown that executives in every field tend to have above average vocabularies. If you know you're weak here, or in the spelling or grammar department, correct these deficiencies before they hurt your chances.

Does time fly? If it seems to stand still, chances are your future is progressing at the same clip. There's nothing wrong with clock-watching so long as you can use the clock as a stimulus to work, not as an escape from it. If you find your job so dull that you can count the hours, maybe there's another position within the company that would be more congenial.

Are you an optimist? A good executive is optimistic and enthusiastic about his job and his company, and seeks to foster this constructive approach in his coworkers. Do you try to create good will for your company—both on and off the job? "Talk up" your firm when you're among friends, instead of joining the futile chorus of gripers.

Are you ahead of the competition? The best way to time your speed in the race for success is to keep a record of your performance. No matter what your job is, note how much you accomplish each week or each month. After a while, you'll find yourself automatically setting goals, concentrating on beating your most important competitor—the you of last year or last month. In the process, you'll have developed a vital leadership quality, because you can then help others improve their performance. ★

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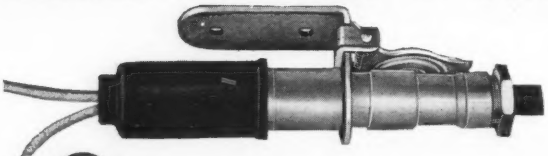

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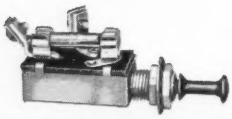

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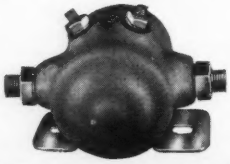

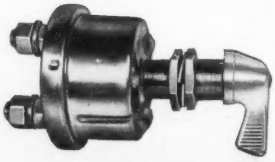

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Designers' book shelf

Electric Machinery, by C. C. Carr, head of department of electrical engineering, Pratt Institute, Brooklyn, N.Y. Publisher — John Wiley & Sons, New York. 540 pages. Price: $9.50.

Written by an author who has been teaching electric machines as an integrated subject for many years, this book provides a review of electric machinery. It includes transformers as well as both direct and alternating current machines. The book covers the topics common to all electric machines, such as windings, voltage relations, energy losses, efficiencies, ratings and basic torque relations.

Circle 300 *on Reader Service Card*

* * *

Nuclear Reactor Materials, by R. B. T. Frost and M. B. Waldron, both principal scientific officers with the United Kingdom Atomic Energy Research Group at Harwell. Publisher— Temple Press, London. 80 pages.

The purpose of this book is to explain to design and other engineers the basic properties of the materials which they will be called upon to use in the nuclear power field. The general properties of the nuclear metals (from beryllium to uranium), structural steels, graphite and ceramics are discussed in relation to nuclear applications. Their performance when in contact with water, steam, gases and liquid metals is examined.

Circle 301 *on Reader Service Card*

* * *

Engineering Economics for Professional Engineers' Examinations by M. Kurtz, a licensed P.Eng. in New York. Publisher — McGraw-Hill, Toronto 4. 260 pages. Price: $7.50.

Here is a book devoted exclusively to helping student engineers prepare for the engineering economics section of the P.Eng. examinations. The book covers many of the important aspects of engineering economics including the media of investment, amortization of loans, valuation of bonds, depreciation, capitalized cost, Kelvin's law, professional ethics, the use of index numbers. Technical terms in finance and economics are defined and essential mathematical principles reviewed. Problem assignments are included.

Circle 302 *on Reader Service Card*

* * *

Introduction to Matrix Analysis by Richard Bellman, mathematician with the Rand Company. Publisher — McGraw-Hill, Toronto. 330 pages. Price: $11.50.

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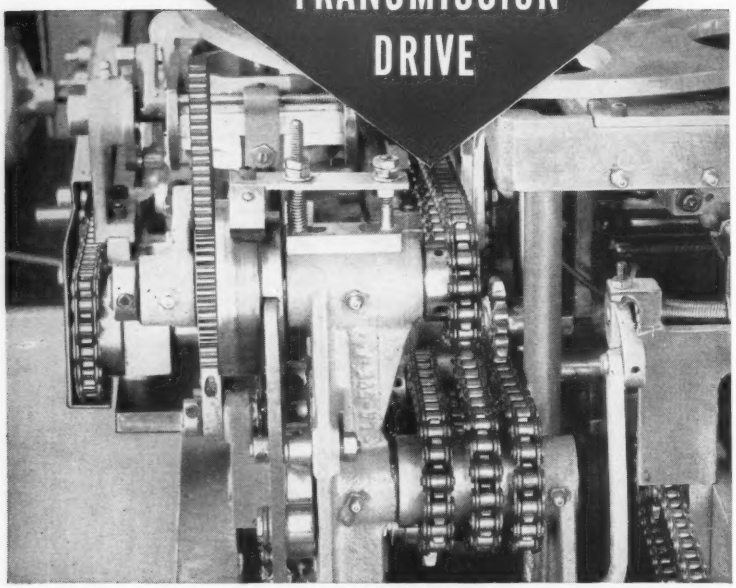

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Keeping informed

Heat Exchangers—15-page catalogue of shell and tube heat exchangers. Young Radiator Co.

Circle 304 *on Reader Service Card*

Marine diesels—Diesel engines for work and pleasure boats. General Motors Diesel Ltd.

Circle 305 *on Reader Service Card*

Turbocharged compressors—Bulletin on gas engine driven, turbocharged compressors. A redesigned line. Clark Bros., Co.

Circle 306 *on Reader Service Card*

Molded packings—Completely revised list of molded packings. Contains service recommendations, design and application data, as well as other information. 52 pages. Canadian Johns-Manville Co.

Circle 307 *on Reader Service Card*

Vulcanized fibre—Here is an engineering handbook for designers and engineers that gives pertinent and up to date information about vulcanized fibre. It's a compilation of the recent series "Fibre Facts for Engineers. Spaulding Fibre.

Circle 308 *on Reader Service Card*

Manual welding—Manual welding equipment is described in this 20 page catalogue. Every torch available from this company is illustrated while accessories are described and listed. Linde Co.

Circle 309 *on Reader Service Card*

Measuring instruments—Illustrated booklet on a 7-in. line of precision, bench type, portable, electrical measuring instruments from Germany. Includes single and multi-range voltmeters, ammeters and wattmeters. Canadian Research Institute.

Circle 310 *on Reader Service Card*

Voltmeters—Recently appointed to handle Ballantine voltmeters in Eastern Canada this company now offers an illustrated folder on these instruments. Bayly Engineering Ltd.

Circle 311 *on Reader Service Card*

Leakproof pumping — The use of this company's line of Chempump pumps in the nuclear field is discussed in this 7-page technical bulletin, No. 4. Also lists organizations presently using these pumps for that purpose. Fostoria Corp.

Circle 312 *on Reader Service Card*

Inconel tubing — Specifications outlining the quality and technical requirements of Inconel tubing for use in heat exchangers in radioactive service. Also describes types available. Superior Tube Co.

Circle 313 *on Reader Service Card*

Hose lines — Industrial catalogue lists hose, fittings, self-sealing couplings and related products from this company. Specifications and application data are included in the 36 pages. Aeroquip Corp.

Circle 314 *on Reader Service Card*

Keeping informed

Variable speed pulleys—A line of variable speed pulleys, plus related equipment including compound drives, motor bases and frames, wide V-belts and sheaves, is described in this 24-page illustrated technical catalogue. Hi-Lo Mfg.

Circle 315 *on Reader Service Card*

Meter-relays—Highly accurate, specialized, expanded scale meter-relays are described in a 12-page catalogue. Information is included on dimensions, prices and typical circuitry. Assembly Products Inc.

Circle 316 *on Reader Service Card*

Electron Microscope — A 6-page folder describes scientific investigations at the Franklin Institute that involve a wide variety of electron microscope problems. Folder is a reprint from the Norelco Reporter. Phillips Electronic Instruments.

Circle 317 *on Reader Service Card*

Oil tanks—The design, production and testing of engine oil tanks for aircraft and missiles is discussed in an eight-page booklet from United Aircraft Products.

Circle 318 *on Reader Service Card*

Air-actuated transmissions — Specifications on a range of transmissions that includes standard, torque convertor and fluid coupling models. Gearmatic Co.

Circle 319 *on Reader Service Card*

Small basic switches—is the title of a 20-page catalogue that covers four micro switch groups. Typical auxiliary actuators and assemblies are also shown. Honeywell Controls Ltd.

Circle 320 *on Reader Service Card*

Electronic equipment—A 24-page illustrated booklet describes this company's electronic equipment production facilities. Canadian General Electric Co., Ltd.

Circle 321 *on Reader Service Card*

Teaching servo systems — A report that describes a new method of teaching servo systems in engineering schools. Servo Corp., of America.

Circle 322 *on Reader Service Card*

Explosion-proof housings—16-page catalogue describes cast aluminum, explosion and weather proof housings for instruments and switches. Adalet Mfg. Co.

Circle 323 *on Reader Service Card*

Rotocycle meter—Bulletin describes the new type 2S meter from this company for petroleum and industrial applications. Rockwell Mfg. Co., of Canada Ltd.

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Silicone fluids—The engineering properties of silicone fluids, assembled in a handy design file with charts. The Bakelite Co.

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People in the news

T. H. Beard, B.A.Sc., P.Eng., becomes chief engineer of a new company, Fluid Power Ltd., that has purchased the manufacturing rights and facilities of Viceroy Mfg., Co., Ltd. Active as a lecturer and writer (he has bylined several DE stories), Beard also assisted in the establishment of the Institute of Production Engineers.

★ ★ ★

John H. Bolton, managing director of the Foxboro Co., Montreal, has been elected president of the Industrial Instrument Manufacturers Association.

★ ★ ★

R. R. Willis, P.Eng., has been appointed vice-president and general manager of Ross Engineering of Canada Ltd.

★ ★ ★

In his new position as vice-president **Joseph H. Reiff** will be in charge of all manufacturing engineering for Houdaille Industries. Canadian operations of this company include Provincial Engineering Ltd., Strippit Tool & Machine Co.

★ ★ ★

Chipman Smith

Stephens

Richardson

H. R. McKnight, P.Eng., has been appointed to the position of Manager, truck engine sales, by General Motors Diesel Limited, London, Ontario.

★ ★ ★

R. O. Bass, President, Morse Chain of Canada, Ltd. has announced the appointment of **Gene A. Stephens,** mechanical engineering graduate from the U. of T., to the position of General Sales Manager, with headquarters in Toronto.

There are two new appointments in the special projects group of Bristol Aero-Industries Ltd., Winnipeg. **Albert W. Fia, P.Eng., A.F.R.Ae.S.** becomes chief design engineer. **William N. Isberg, P.Eng.,** has been made sales engineer for the group.

★ ★ ★

Roger Duval has been appointed manager of municipal sales in Quebec, the Maritimes and Newfoundland for Canada Iron Foundries Ltd.

★ ★ ★

New manager of Hartman Metal Fabricators, Ltd., is **J. J. Craddock.** He previously worked with various engineering companies in Montreal.

★ ★ ★

Harry H. Lightbrown, P.Eng., has been appointed chief engineer for the Dodge Mfg. Division of United Steel Corp., Ltd. He is a mechanical engineering graduate of Toronto University.

★ ★ ★

Hector Roberge, president of H. Roberge Inc., has been elected to the board of directors of Canmark Services Ltd., of Toronto.

★ ★ ★

Canada Metal Co., Ltd., has elected a new president. He is **Carleton Smith** who has been with the company since 1933. Most recently he has been general manager.

★ ★ ★

Dr. A. D. Misener, F.R.S.C., will take over as Director of the Ontario Research Foundation, on completion of the academic year at the University of Western Ontario, where he is Professor and Head of the Department of Physics.

★ ★ ★

Distribution and Specialty Transformers of Canadian General Electric has a new manager in the person of **R. D. Richardson.** Mr. Richardson moves up from Peterborough, where he was Manager-Finance in the Apparatus Department.

★ ★ ★

Kenneth W. Davies has been appointed sales engineer, specializing in transmission equipment, with the Ontario division of Dominion Engineering Co., Ltd. He joined the company in 1950 after graduation from McGill University.

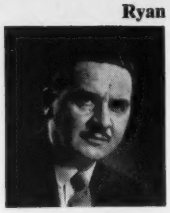
★ ★ ★

Paul Doyon has become branch development engineer at the Toronto branch of Canadian Liquid Air Co., Ltd. He previously was development engineer at the company's head office.

★ ★ ★

Also announced by the Canadian Liquid Air Co., Ltd. is the appointment of **George Griffiths,** P.Eng., as manager of the production department at the company's head office. He has been assistant manager since 1957.

Ryan



Lightbrown

Isberg

Fia

Arthur A. Ryan, supervisor of engineering services at Canadian Westinghouse Co., Ltd., has been elected president of the Graphic Reproduction Association.

★ ★ ★

Another honor for **Dr. Richard L. Hearn, P.Eng.,** director of Atomic Energy of Canada Ltd., as he is elected an honorary member of Britain's Institute of Electrical Engineers. The award is made only once every three years.

★ ★ ★

Toronto graduate **Robert P. Charette, B.A.Sc., P.Eng.,** is the new sales engineer for Canadian Ice Machine Co., Ltd., in the Province of Quebec. Educated also at the University of Lausanne, Switzerland, he is a member of the Professional Engineers Associations of both Ontario and Quebec. Another engineer, trained in Paris, France, **Roy A. LeVoi,** has been promoted to manager of the company's operations in the Province of Quebec.

★ ★ ★

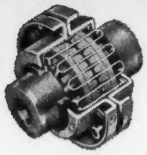
D'Arcey Kelley will represent Morse Chain of Canada Ltd. in Eastern Ontario, Quebec and the Maritimes.

★ ★ ★

Newly elected president of the Association of Consulting Engineers of Canada is **R. R. Duquette,** P.Eng. He is a member of the Montreal consulting firm of McDougall and Friedman. A director of the association since 1958, he was vice-president in 1959.

★ ★ ★

Harold R. Chipman becomes manager of new product development for Dominion Rubber Co., Ltd., according to a company announcement. A graduate of Arcadia University, he has been with the company for 13 years.



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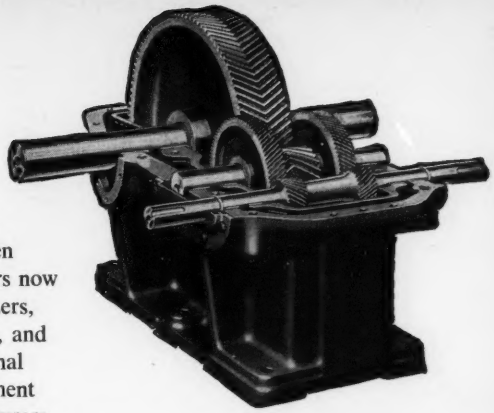

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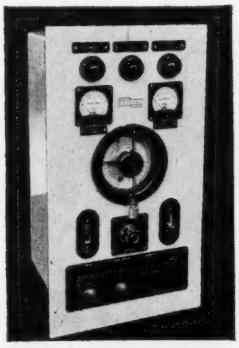

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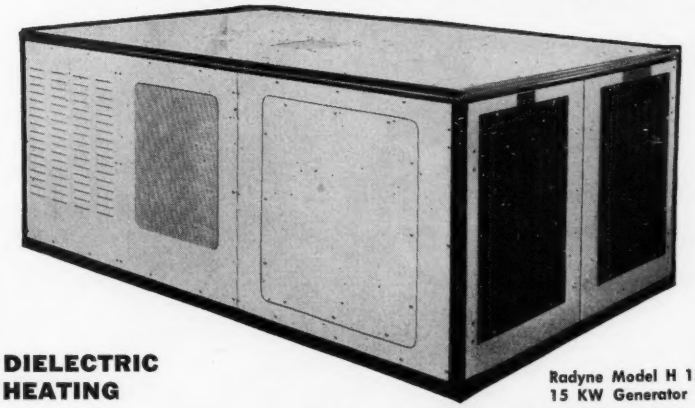

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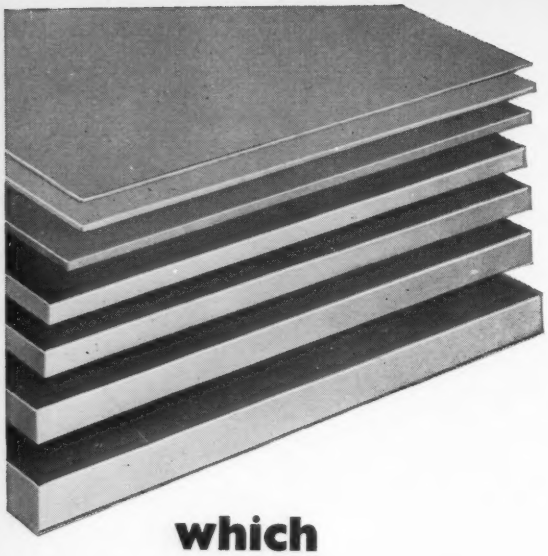

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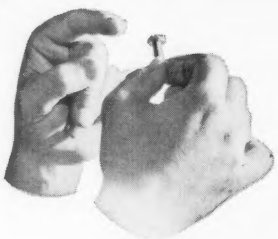

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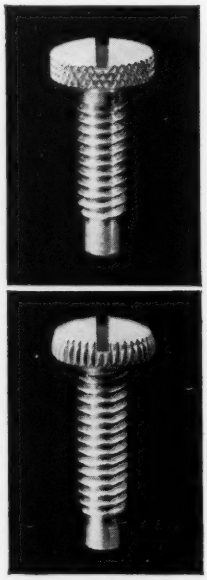

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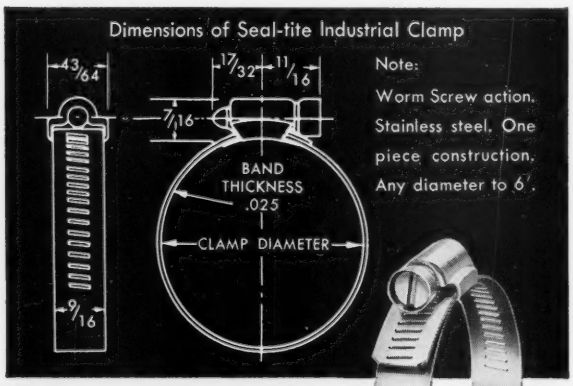

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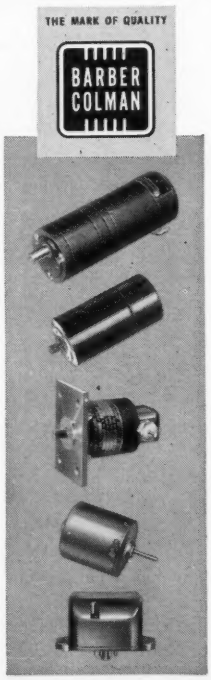

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Briefs

We note with interest . . .

Four major oil companies are conducting joint research in an effort to release oil from the Athabasca sands . . . **Manufacturers** of nuclear products are assured a market of $34 million annually for the next five years, says Atomic Energy of Canada Ltd. . . . **Canadian General** Electric Co., Ltd., is developing a nuclear reactor that would use a petroleum product instead of heavy water . . . **Mouth to mouth** method of resuscitation is now easier and more effective with equipment developed by Dr. Morris H. Brook of Saskatoon . . . **Another idea** goes south—U. S. company has bought designs and patents of nuclear steam generator developed by Montrealer Winnet Boyd . . . **A folding church** is being trailed and used around Alberta. Church is really complete and even includes a steeple . . . **A mouse** in an open box will not be alarmed if you ring a bell in his ear. Do the same thing when he's in a small escape-proof box and he'll become frenetic. So researchers working on tranquilizers found . . . **The tiny diode,** used in complex computers and industrial control equipment, is no larger than the flint in a cigarette lighter . . . **Editors,** particularly DE's, are squirming uncomfortably in their swivel chairs. An electronic computer has just edited a 965-page book on the poet Matthew Arnold . . . **Just heard** about an English lady, born in 1880, who was blessed with 25 christian names, a name for every letter except P. Friends called her Alphabet for short . . . **Is this playing** the game? — fishermen on the U. S. East Coast are using bubbles to drive herring into their nets . . . **Louis Polk, Sr.,** president of the Sheffield Corp., has been elected a Fellow of the American Society of Mechanical Engineers . . . **Member of** a British team currently rechecking Einstein's General Theory of Relativity is Dr. A. B. Whitehead, of New Brunswick . . . **George** is a ghastly sight. He has gaping jaws and a shining dome. He's an aluminum model for Toronto dental students . . . **American Vacuum** Society is filling the voids of October 12-14 with a national symposium . . . **Big U. S. order** for the Rolls Royce Company — $9.24 million for Avon jet engines . . . **Tiny transmitter,** carried in the pocket, opens and closes the garage door for you . . . **With 46** of its newly designed buses sold in Western Canada Canadian Car Co. is now setting its sights on Toronto . . . **An endless belt** machine has been designed by a partially blind Englishman to help teach convalescents to walk again . . . **A Canadian** built satellite is to be put into orbit by the U. S. in November, 1961 . . . **Davie Shipbuilding Ltd.** are using a new Finnish method of straightening welded plate surfaces . . . **Canadian designed** electrolytic hydrogen plant is selling around the world . . . **B. C. lumbermen** are being told to find more use for their waste materials. In effect: invent wasteless waste . . . **A look** into the future: Trans-Canada pipe lines for food, minerals and woodchips . . . **British machine** will peel onions perfectly—without tears . . . **Mush, you huskies.** Runners of sleds are now being given a fibreglass coating . . . **Japanese pump** manufacturer is taking a look at Saskatchewan with the idea of opening a plant there . . . **Pretty soon** you'll be able to give your irreplaceable records protection from atomic attack. A vault for this purpose is being built near Toronto. Of course, after the bomb you may not be here to pick up your papers again. Not unless you're quick and squeeze in with the files . . . **The U. S. has** agreed to contribute $5 million to Canada's nuclear power program . . . **How's this** for an experiment: the Danes are building a town in Greenland under the ice. Electricity will be supplied by atomic power . . . **First advance** in the field since the ancient Egyptians, perhaps! A jet flame that carves stone . . . **Lightweight turbine** engine being developed by Canadian Pratt and

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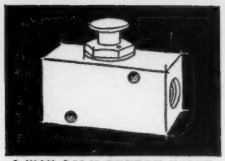

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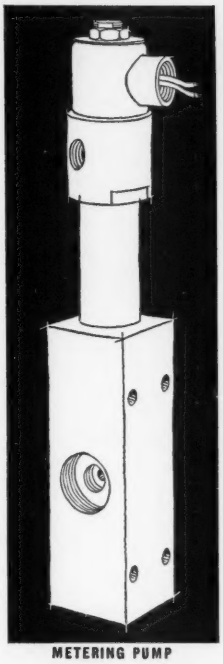

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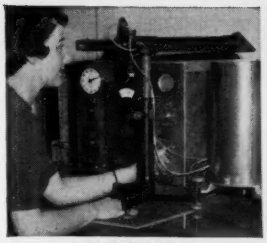

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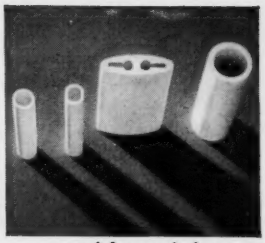

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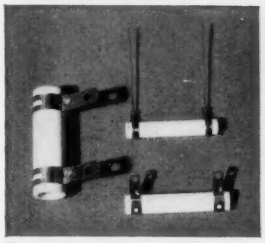

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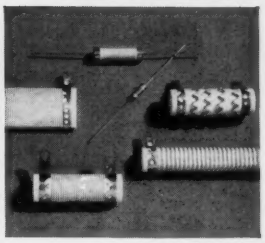

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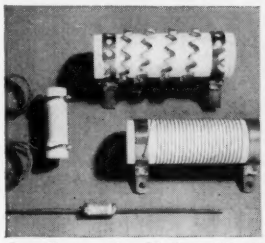

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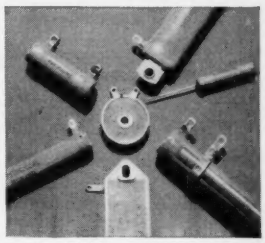

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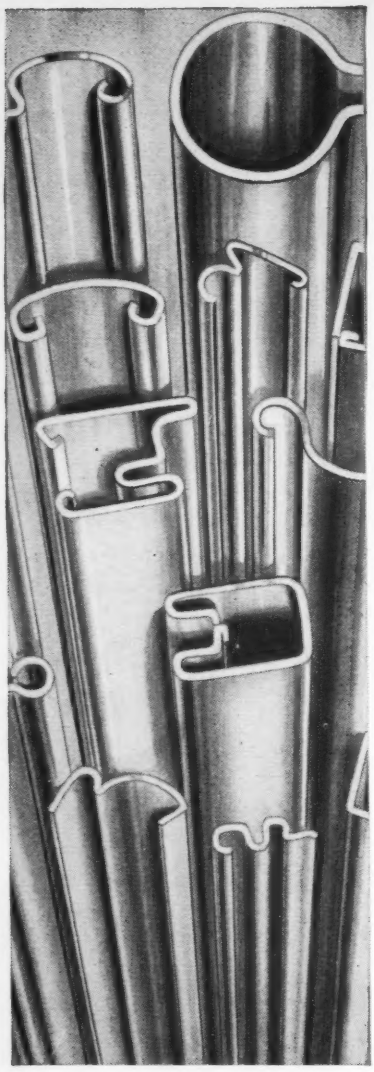

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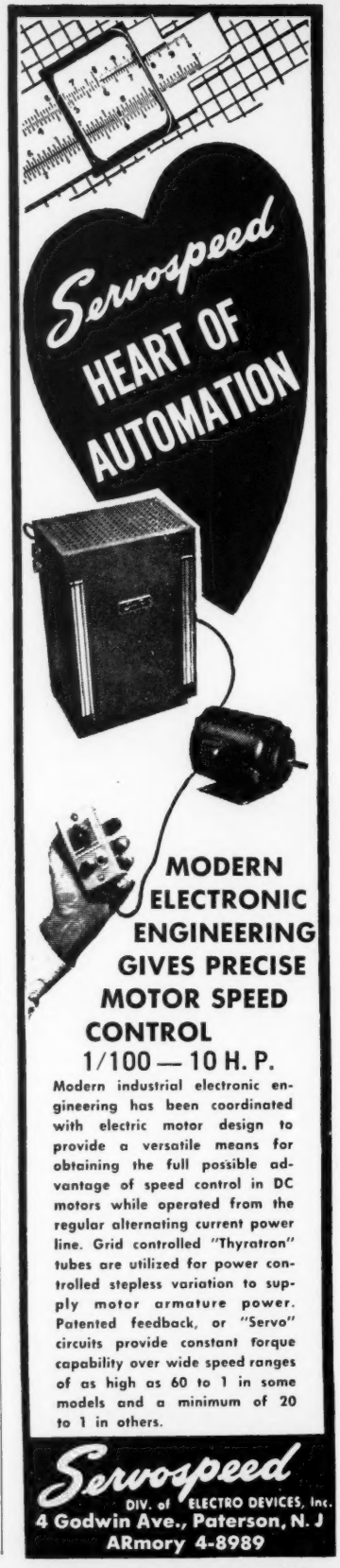
Briefs — *continued*

Whitney could revolutionize small plane flying if successful . . . **Congratulations** to A. F. Christie and D. J. Skinner, engineering students at Nova Scotia Technical College, who have received fellowships to continue their studies in the U. K. . . . **If you watch** TV with your girl friend take care what you do in the darkened room. Market researchers now have a device that will take pictures of TV viewers—a sort of reverse TV. Already it has taken some interesting scenes. So like we said . . . **Big hit** at a recent New York show was a Canadian designed grinding machine for automotive cylinders . . . **Berylometer,** for detecting beryllium in metals, is the invention of a Winnipeg firm . . . **Bubble gun** 'burps' warm water from the bottom to melt surface ice. Gun 'burps' 1,000 cu. in. of air every 30 seconds . . . **Canadian engineering** company is looking for a way to color road paving. Would certainly help at complicated cloverleafs, but watch out for color blind drivers . . . **Here's a subject** worthy of research: Reducing the engine noise of jet aircraft. The ear drum you save could be your own . . . **Architects** are urging Victoria, B.C., city council to hold a design competition for their new city auditorium . . . **The British government** have ordered "feasibility tests" be made on supersonic airliners. Top guess for development costs is about $540 million, give or take the odd dollar . . . **Polaroid's** 'picture-in-a-minute' system is due to offer color shots but the company won't say when . . . **U. S. Marine Corps** is now testing one-man helicopters. The craft can carry 250 pounds and has a top speed of 70 mph . . . **American Society** of Tool Engineers has changed its name to American Society of Tool and Manufacturing Engineers . . . **New CBS** Laboratories system can transmit photographs from aircraft or satellites to stations on the ground without any loss of detail . . . **Terylene may** challenge rayon and dacron as cord for automobile tires if current tests prove successful . . . **Thermometer cuff** links and tie clips measure from —20 to 120F . . . **Russia is placing** a small car on the Canadian market to sell at about $1,500. But beware extravagant claims—it will not go to the moon . . . **Brief talepiece**—Now smell this. Now smell this. U. S. company is now marketing fragrant polyethylene packaging with such aromas as "clean linen." Idea is that ladies' little things will be packed with a fine perfume; men's wear with more manly odors. Dozens of different scents are being used. But, oh, what a stink will be raised if there's confusion in the packs. Can you imagine getting a pair of socks with the odor of garlic built in?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MODERN ELECTRONIC ENGINEERING GIVES PRECISE MOTOR SPEED CONTROL
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Modern industrial electronic engineering has been coordinated with electric motor design to provide a versatile means for obtaining the full possible advantage of speed control in DC motors while operated from the regular alternating current power line. Grid controlled "Thyratron" tubes are utilized for power controlled stepless variation to supply motor armature power. Patented feedback, or "Servo" circuits provide constant torque capability over wide speed ranges of as high as 60 to 1 in some models and a minimum of 20 to 1 in others.
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New products and materials

Speed Clip

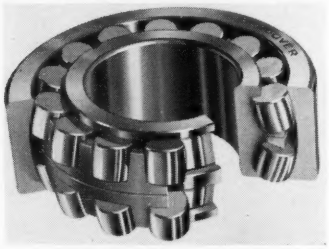
A new speed clip, designed especially to serve as a spacer and to fasten printed circuit boards to chassis in electronic equipment, was announced today by **Dominion Fasteners Ltd.,** Hamilton, Canadian licensee and manufacturer of Tinnerman Speed Nut spring tension fasteners.

The new, one-piece clip, made of spring steel, is self-retained in fastening position for faster, easier assembly. This is accomplished through the use of its bowed spring legs which snap into place and lock on the underside of the chassis. Once the clips are in place the circuit board is positioned and screws are inserted, passing through the board and between the spring legs of the clip into the chassis. The clips provide better than half-inch clearance between circuit board and chassis.

To prevent the possibility of cracking the brittle phenolic circuit board due to over-torquing of the screws, the speed clip is designed with a broad, flat head which provides a substantial base at each fastening point.

Circle 326 *on Reader Service Card*

Spherical roller bearings



Spherical roller bearings have now been added to the bearing line of **Hoover Ball & Bearing Co.**

The bearings are designed with a double row of large-size rollers to accommodate excessively heavy radial and shock loads. High contact angle provides for substantial thrust capacity in either direction. A single spherical outer raceway permits the bearing to compensate automatically for shaft misalignment in any direction, either initially or dynamically under load.

Circle 327 *on Reader Service Card*

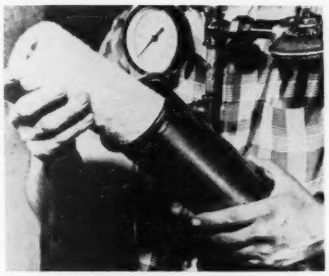
Insulated riser sleeve

A new type of riser sleeve for nonferrous casting is offered by **Canadian Johns-Manville Co., Ltd.**

Made of expanded silica and a binder the new sleeve, called Ris-A-Sleev, is said to considerably reduce heat transfer, causing prolonged feedback time and greater uniformity of the molded metal. It will not contaminate sand and is said to be ideal for blind risers. It is available in a wide range of diameters and in lengths from four to eight inches.

Circle 328 *on Reader Service Card*

Precision filters



A filter cartridge, said to give precise filtering, is available from the **E. F. Walter Co.**

Called the Feutron, the cartridge has an aluminum core and viscose fibre filter media. This combination of materials is said to provide the widest possible practical use range involving water, oil and solvent applications. The cartridge is of single density throughout the micron range. The precise micron control of the filter is accomplished through the use of fibres of graded denier.

Circle 329 *on Reader Service Card*

Altitude linear system

Sostman Linear Altitude Transducers and Bristol Dynamaster Recorder-Controllers have been combined for accurate measurement, recording and controlling, of simulated altitude test conditions.

The transducer converts pressure to an electrical signal in the Dynamaster instrument. Much greater readability is obtained over the entire scale with respect to altitude because the Dynamaster output is linear. The transducer and the receiver are calibrated together for maximum system accuracy. Standard ranges are from 0 to 50,000 ft to 0 to 150,000 ft altitude but greater ranges are available on request. **The Bristol Co., of Canada Ltd.**

Circle 330 *on Reader Service Card*

Atomizing spray nozzles

A line of atomizing nozzles made of hard rubber is being distributed in Canada by **John Brooks & Co., Ltd.**

The nozzles produce a hollow cone spray pattern and atomization is achieved through hydraulic pressure alone. A range of capacities is offered from 1 gph to 25 gph based on operation at 40 psi. All parts of the nozzle are made of hard rubber, offering maximum resistance to acids and related corrosive liquids.

Circle 331 *on Reader Service Card*

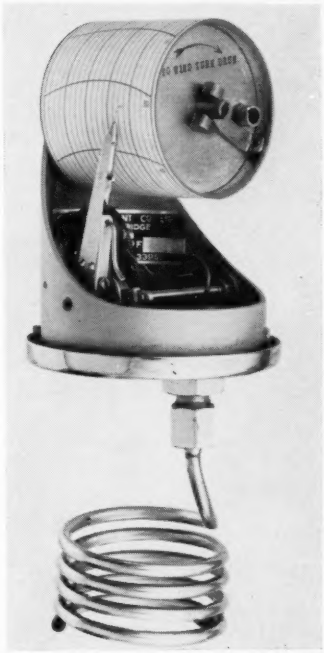
Hydraulic motor valve

A valve has been specially designed by **Fluid Regulators Corp.,** to control the flow into a hydraulic motor.

Maker claims the valve stops hydraulic motor run away, prevents damage to equipment and assures safer working conditions for personnel. It is constructed of all stainless steel and has a bulkhead fitting on the outlet port. It is designed to handle the usual hydraulic fluids and oronite.

Circle 332 *on Reader Service Card*

Miniature temperature recorder



This temperature recorder stands only 6 in. high. Its diameter is 2¾ in. and its weight 1½ lb.

The instrument, called the Cambridge Minican, consists of a chart about 1½ in. wide mounted on a drum that revolves at a constant rate and a pen that is moved by the expansion or contraction of liquid in a stainless steel bulb. Recording covers 2, 12 or 24 hours depending on the clockwork drive built in. Minimum range is 50 F or C across the chart. Accuracy clamed is 0.02 in. on the chart width. **R. H. Nichols Ltd.**

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continued ▶

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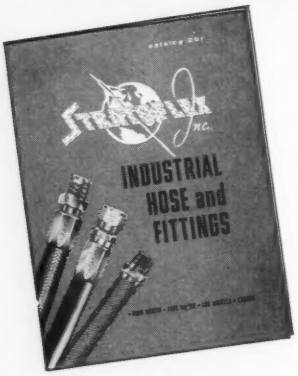

New Stratoflex Industrial Hose and Fittings Catalog contains 64 pages of helpful information on fluid and pneumatic lines and fittings.

New Stratoflex Fluid Power Components Catalog covers pumps, motors, valves, cylinders and power units.

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Address_____

For further information mark No. 152

New products

Continued from page 77

Rust preventive coating

A rust preventive system for metal, consisting of a primer and finishing paint, has been developed by the **Glidden Co., Ltd.**

Important feature of the new finish, called Rustmaster, is that it may be applied over the rust itself. The primer penetrates through the rust layers to the metal beneath, forcing out pockets of moisture and air. The paint is available in a wide range of colors, in cans for brushing and in a 16 oz spray can.

Circle 334 on Reader Service Card

Silicone rubber stock

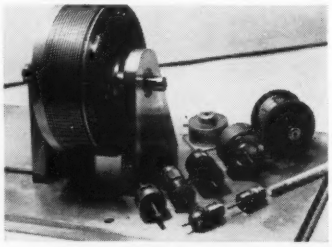
Two types of low shrink silicone rubber stock for cable and wire insulation have been added to the lines of the **Bakelite Co.**

The first, K-1347 Silicone Rubber Compound, is designed for use in conditions of extreme heat and cold. It can be continuously vulcanized on standard equipment . . . The second, K-1357, is designed to give excellent electrical and physical properties at moderate cost. It is available in coiled strips for direct feeding to the extruder. Both compounds are white but can be color coded as desired.

Circle 335 on Reader Service Card

Magnetic clutches and brakes

A line of industrial clutches and brakes, to be used for precise tension controls,



zero backlash actuators and fan drives where high starting torques are encountered, are now being manufactured in Canada.

Design of these units permits the stored energy of the motor to be utilized. The clutches and brakes employ no mechanical friction members. Torque is proportional to excitation and the drive may be synchronous, without slip, on demand. Eddy current effect is insignificant so that torque or braking force is independent of slip speed.

The hysteresis units are being manufactured under license by **Found Bros. Aviation Ltd.**

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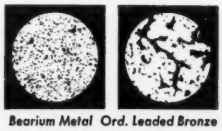
So, if you have a bearing application which involves high speeds, poor lubrication, excessive loads, elevated temperatures, dusty and gritty surroundings—or where a liquid other than oil must be used as a lubricant . . . BEARIUM METAL will prove to be your best investment.

THE SECRET OF BEARIUM METAL'S superiority is due to the uniform distribution of microscopic lead particles within the copper-tin grains rather than between the grain boundaries—as illustrated by these two photomicrographs.



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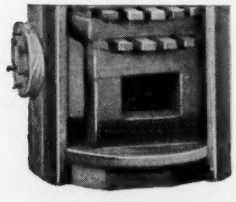


For further information mark No. 111

New products and materials *continued*

Micro-hardness tester

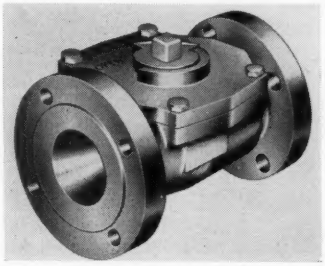
A micro-hardness tester, Model H5, for rubber, rubber-like materials and plastics has been introduced by **Testing Machines Inc.**

The basic machine consists of an indentor and a means of applying a minor and then a major load. It permits the hardness of small parts, sheets and irregular shapes to be measured directly. The depth of indentation is measured.

Circle 337 *on Reader Service Card*

Fixed bearing ball valves

Ball valves with the ball mounted in fixed bearings are featured in a new series from **Hydromatics Inc.**



The valve, designed series 711, is engineered on the fixed bearing principle in which the ball rotates on a fixed axis between bearings that require no lubrication. It is said to be able to absorb tremendous impacts and loading without back-lash or danger of distortion.

Maintenance feature is that the valve can be disassembled and serviced without removing it from the line.

Circle 338 *on Reader Service Card*

This punch notches and nibbles

A new model electrical head fabricator has been introduced by the **Strippit Tool & Machine Co.** The machine is designed for punching, notching and nibbling, particularly for prototype work, short or medium production runs.

The machine is designed to punch round or shaped holes up to 3½ in. dia in any sheet metal, including printed circuit boards, up to ¼ in. mild steel. Its maximum notching capacity is 5x5 in. in ⅛ in. mild steel. It will do straight line or contour shearing at 165 strokes per minute in ⅛ in. mild steel.

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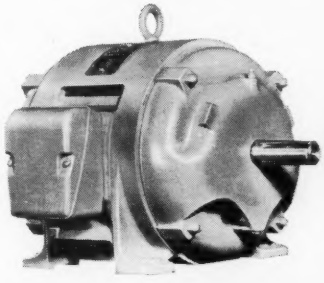

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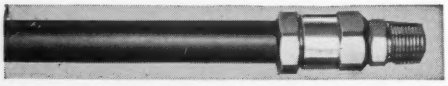
. . . Available Now Nationwide!

It's brand-new from Alemite! For the first time, this famous manufacturer offers you *reusable, non-skive* couplings and rubber hose—exclusively designed for faster, more economical replacements . . . to cut maintenance costs, downtime and inventories!

Rugged Alemite Hose is available for either medium-high or high-pressure service, with single or double wire braid. Couplings of high-strength steel have J.I.C. thread design for positive, long-lasting seal.

Only Alemite Surgepruf Couplings Offer All These Advantages:

- **NO HOSE-SKIVING REQUIRED! "Double-wedge" grip forces coupling threads through rubber cover . . . grips either single or double wire braid solidly. Saves both time and labor.**
- **GIVES TIGHTER GRIP! Double-wedging action gives tighter grip as insert is drawn farther into coupling.**
- **NO SPECIAL ASSEMBLY TOOLS REQUIRED! Fast, easy assembly with just ordinary tools.**
- **Types and sizes for all hydraulic lines!**



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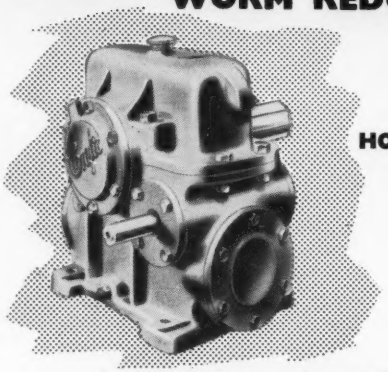

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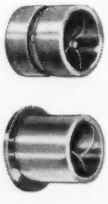

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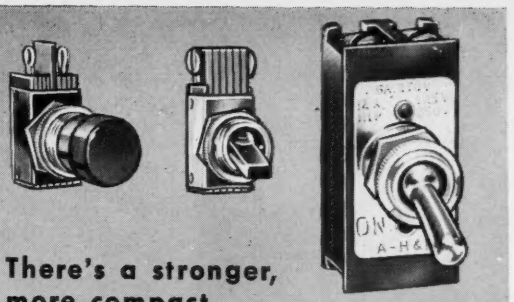

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Editorial

The Canadian engineer in public life

.... the theme is gaining momentum

Alex MacDonald's article "The Canadian engineer as a lawmaker," which appeared in our February issue, appears to have set some of Canada's professional engineers thinking—and has even stirred them, and their provincial associations, into action.

You will remember that MacDonald berated the engineers for their apparent disinterest in the federal and provincial governments of the country. Out of 35,000 registered engineers in Canada, only 8 sit in the governing assemblies. And only three are members of the federal house.

Now let's look at some of the events which have happened since the article appeared in print.

- The complete article has been reprinted in the March issue of the "Alberta Professional Engineer," the official organ of the Association in that province. President Stollery, in his regular column in the same issue, says, "It is a fact that there are all too few of us who are willing to take part in politics or civic affairs. This, I think, is a shame and also damaging to our national welfare."

- The Corporation of Professional Engineers of Quebec have adopted as their theme for the next year "The engineer in public life." Speaking at the annual general meeting in Montreal on March 19, president W. J. Riley had this to say: "By setting our theme as "The engineer in public life" we had only one motive. That was to encourage all professional engineers to take a more active interest in public affairs . . . The fact which interests us most in Quebec is that our own membership of 8,500 includes all 3 of the federal, and 1 of the provincial parliamentarians."

The four lawmaking engineers from the CIPQ were then presented with illuminated scrolls attesting to the high esteem in which they were held by their fellow engineers.

- The Association of Professional Engineers of Ontario have requested permission to reprint MacDonald's article in their publication, so that all 19,000 of their members may have this important matter brought to their attention.

- Dean R. R. McLaughlin of the University of Toronto Engineering Faculty feels so strongly on the subject that he is attempting to have it discussed in the Wallberg Series of lectures to be held next fall.

Also in the February issue was a 16-page feature report on the Canadian design and drawing office.

- Fifteen thousand reprints of this report were ordered by interested companies across Canada for distribution to their clients, at conventions, and to schools and industry.

- Curry's Art Store, Toronto, one of the recognized leaders in this field, put in a special window display for February featuring the DE reprint, and offered copies free for the asking.

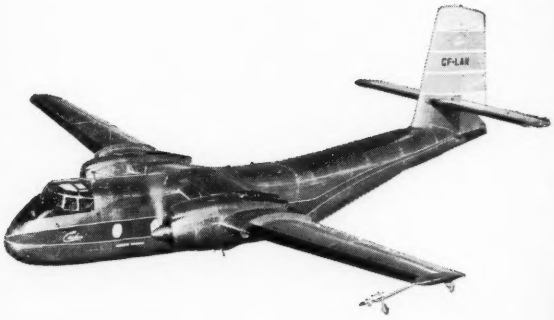
- **The March issue,** too, carried a feature report, this time on the copper and brass industry. Some 6,500 reprints of the 32-page report were distributed throughout Canada and many foreign lands by the Canadian Copper and Brass Development Association.

The staff of DE feels flattered, of course, with the reception given these features. But the credit really belongs to the contributors who actually authored all the articles. We are satisfied to know that we are reporting items of such interest to the engineers of Canada. That after all, is why we exist.

Curry's Art Store features DE

Doug Kaill

case history of the month



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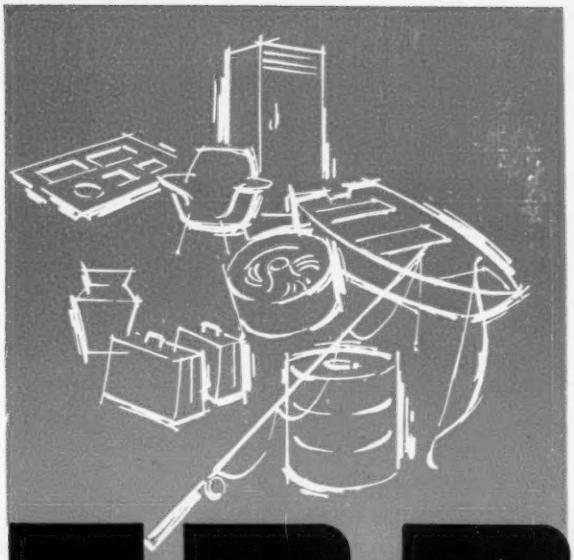

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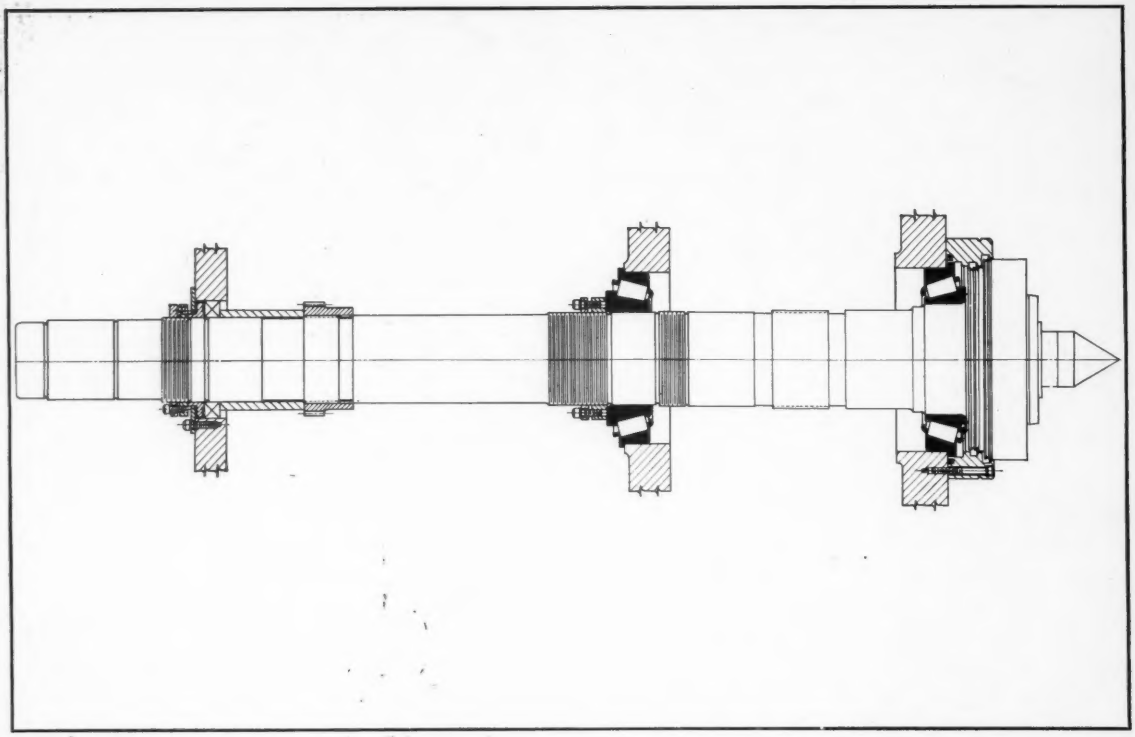
How Monarch assures rigidity, accuracy, with Timken bearings in "Dyna-Shift" lathe



IN designing their Series 90 Dyna-Shift lathe that can be kept under full load at any speed, Monarch engineers wanted to be sure of rigidity, accuracy and economy. By using 30 Timken tapered roller bearings at vital points—spindle (shown above), gear box, apron and tailstock—the engineers achieved their objectives. Results from the "90", reports Monarch, show up to 25% more output and 50% greater tool life than with other equipment.

Most American machine tool design engineers use Timken bearings. Two big reasons are: 1) The taper lets Timken bearings take radial and thrust loads in *any* combination. 2) Precision manufacture of Timken bearings assures high precision in the machines.

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